FACTORS UNDERLYING THE IMPROVEMENT OF L2 PHONOLOGICAL PRODUCTION USING TECHNOLOGY OUTSIDE THE CLASSROOM

A Dissertation in

Spanish

by

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ABSTRACT

When learning a foreign language, it is generally noted that focus on pronunciation is overlooked as curricula are often based on the language’s morphosyntax (Elliot, 1995a; Lord, 2005). The purpose of this study is to determine the effects of using technology outside the classroom to improve abilities in the second-language learner's L2 phonological system. It is hypothesized that by completing speech perception exercises outside the classroom via the internet, and also by manipulating the variables of metalinguistic explanation and type of feedback, the second-language learner will improve his/her production of target L2 sounds without disruption to the course program.

This dissertation is based on two studies carried out at Pennsylvania State University. Study 1 took place during Spring semester 2008. All participants were students of Spanish 110 (Intermediate Spanish Conversation). Participants (n=12) were randomly placed into one of three groups; the first group (Group A) received audible examples and metalinguistic explanation of the target sound (the nonvelarization of the Spanish segment [l] in the syllable final position). These examples were provided in tasks that the participants completed online, outside of class. The second group (Group B) received only metalinguistic explanation and the third group (Group C) served as the control.

Study 2 consisted of 30 participants who were enrolled Spanish 110 the following semester. In a similar fashion to the first study, participants were divided into three groups. The first received explicit training, audible examples and metalinguistic
explanation (A). The second received explicit training and metalinguistic explanation (B), and the third served as the control group (C). During the course of the semester participants in both studies completed weekly exercises in Spanish perception using ANGEL, the online course management system at Penn State. The groups in Study 2 received short (approximately ten minutes) periods of explicit instruction (one per week in class, for eight weeks). All ‘pre-treatments’ and ‘post-treatments’ were digitally recorded and phonetic analysis was done using Praat Software.

Data from both studies show that the groups receiving both metalinguistic explanation and audible input on ANGEL not only improved the ability to discriminate between L1 and L2 sounds, they also improved production of L2 phones. Furthermore, it was noted that exposure to explicit feedback and metalinguistic explanation had substantial roles in improvement of Spanish L2 phonology. Most significantly, all groups improved their L2 phonological production when compared to the control groups, supporting the notion that phonology can be supplemented to lower levels of language learning without changes to the curriculum.
TABLE OF CONTENTS

LIST OF FIGURES ........................................................................................................ vii

LIST OF TABLES ....................................................................................................... vii

ACKNOWLEDGEMENTS ................................................................................................... x

**Chapter 1: Introduction** .......................................................................................... 1
1.1 Overview .................................................................................................................. 1
1.2 The role of perceptual input in speech production .............................................. 2
1.3 Specific aims and general experiment design .................................................... 3
1.4 Phonetic property under investigation ................................................................. 4
1.5 Organization of the dissertation ........................................................................... 5

**Chapter 2: Forms of Feedback and Other Key Variables in Second-language Phonological Acquisition** ........................................................................ 6
2.1 Introduction .............................................................................................................. 6
2.2 Types of feedback in second-language learning ................................................. 7
2.3.1 Variables in the improvement of L2 phonological production .................... 12
2.3.2 Perceptual input ............................................................................................... 12
2.3.3 Metalinguistic Explanation ............................................................................. 15
2.3.4 Explicit Instruction ......................................................................................... 17
2.4 Conclusion ............................................................................................................. 18

**Chapter 3: Experiment Design and methods of Studies 1 & 2** ................................. 19
3.1 Introduction .............................................................................................................. 19
3.2.1 Participants and subject groups of Study 1 .................................................... 21
3.2.2 Participants and subject groups of Study 2 .................................................... 22
3.3 Differences in coda velarization in English and Spanish .................................... 24
3.4 Acoustic characteristics of [l] and [t] .................................................................... 25
3.5 Pretest ..................................................................................................................... 30
3.6 Method of online testing ....................................................................................... 30
3.7 Posttest ................................................................................................................... 31
3.8 Method of assessment ......................................................................................... 31

**Chapter 4: Results of Study 1** .................................................................................. 33
4.1 Introduction .............................................................................................................. 33
4.2 Participants and results of weekly perception tasks ........................................... 33
4.3 Exploratory data analysis ...................................................................................... 37
4.4 Analysis of Covariance (ANCOVA) using SAS 9.2 ............................................ 41
<table>
<thead>
<tr>
<th>Chapter 5: Results of Study 2</th>
<th>5.1 Introduction</th>
<th>5.2 Results of speech perception and production tasks</th>
<th>5.3 Speech production statistical analysis</th>
<th>5.4 Exploratory data analysis</th>
<th>5.5 Analysis of Covariance (ANCOVA)</th>
<th>5.5 Residual Issues</th>
<th>5.6 Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chapter 6: Conclusion</td>
<td>6.1 Introduction</td>
<td>6.2 The original hypothesis and research question</td>
<td>6.3 Study 1 results</td>
<td>6.4 Study 2 results</td>
<td>6.5 Implications for future research</td>
<td>6.6 More accurate measurements of /l/ velarization</td>
<td>6.7 Residual issues and concluding remarks</td>
</tr>
</tbody>
</table>

Bibliography..........................................................76
APPENDIX A: Language History Questionnaire..........................86
APPENDIX B: Pronunciation Attitude Inventory..........................89
APPENDIX C: Tokens of Word-Naming task of pretest and posttest (both studies)...91
APPENDIX D: Images of Boston Naming Task................................95
APPENDIX E: Introductions to Weekly ANGEL exercises, Groups A & B (both studies) ..........................................................101
APPENDIX F: Weekly treatments of control groups (both studies) .............104
APPENDIX G: Weekly treatments of Groups A & B (both studies) ..............113
APPENDIX H: Class Presentations for Those Groups that Received ET (Study 2)...135
LIST OF FIGURES

Figure 3-1: Spectrogram of the Spanish word ‘difícil’ .................... 28
Figure 3-2: Spectrogram of the English word ‘meal’ ....................... 29
Figure 4-1: Weekly treatment scores of Group A (Study 1) ............. 34
Figure 4-2: Weekly treatment scores of Group B ......................... 35
Figure 4-3: Weekly treatment scores of Group C ......................... 35
Figure 4-4: Group A speech production scores ......................... 39
Figure 4-5: Group B speech production scores ......................... 40
Figure 4-6: Group C speech production scores ......................... 40
Figure 4-7: Box plot of average difference of F2 frequency by group ... 44
Figure 4-8: Estimated Regression lines for six different groups ...... 46
Figure 5-1: Perception scores of Group A (Study 2) .................... 53
Figure 5-2: Perception scores of Group B ............................... 54
Figure 5-3: Perception scores of Group C ............................... 56
Figure 5-4: Production scores of Group A ............................... 57
Figure 5-5: Production scores of Group B ............................... 58
Figure 5-6: Production scores of Group C ............................... 58
Figure 5-7: Histogram for Means ........................................ 61
Figure 5-8: Scatterplot for Difference against Pre-test frequency .... 61
**LIST OF TABLES**

Table 1-1: *Allophonic distribution of [l] and [θ] in English* ......................... 5

Table 2-1: *Example of utterance correction/rejection* ................................ 8

Table 2-2: *Example of metalinguistic feedback* ........................................... 8

Table 2-3: *Example of confirmation check* .................................................. 10

Table 2-4: *Example of clarification request* ................................................ 10

Table 2-5: *Example of comprehension check* ............................................ 11

Table 2-6: *Example of recast* ................................................................. 11

Table 3-1: *Blocks of pretest (and posttest, both studies)* ........................... 20

Table 3-2: *Example of sequence of utterances of word-naming task(s)* ....... 21

Table 3-3: *Subject Groups of Study 1* ..................................................... 22

Table 3-4: *Subject Groups of Study 2* ..................................................... 23

Table 4-1: *Subject Groups (Study 1)* ..................................................... 34

Table 4-2: *Blocks of pretest (and posttest)* ............................................ 38

Table 4-3: *Correlation Procedure* .......................................................... 43

Table 4-4: *ANCOVA Type 3 Tests of Fixed Effects* .................................. 45

Table 5-1: *Subject Groups of Study 1* ..................................................... 50

Table 5-2: *Participant groups of Study 2* ............................................... 52

Table 5-3: *Mean and variance for 3 groups (Study 2)* ............................... 60

Table 5-4: *Mean and variance for groups and word class* .......................... 60

Table 5-5: *Type 3 tests of fixed effects* .................................................. 63
Table 5-6: Least square means

Table 5-7: Differences of least square means

Table 6-1: Subject groups for follow-up study/studies

Table 6-2: Subject groups for follow-up study/studies II

Table 6-3: Subject Groups of Study 2
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Chapter 1

Introduction

1.1 Overview

When learning a foreign language at the beginning and intermediate levels, it has been noted that classroom time is generally devoted to four basic language skills: reading, writing, listening, and speaking. However, target language pronunciation itself, as noted by Elliot (1995a) is rarely addressed. This is interesting because native speakers are highly attuned to properties of accentuatedness and are often able to detect a foreign accent in a stream of speech as short as 30 ms (Flege, 1984; Flege & Hammond, 1982; Magen, 1998). Furthermore, when asking a native speaker of any language what they think about the speech of a given L2 speaker, the majority of the time they note the characteristics of the L2 speaker’s ‘accent’ (Lippi-Green, 1997). The current study actually stems from this point of interest, with the aim of assessing if a student’s pronunciation in a second-language, or L2 phonology, could be improved outside the classroom. More specifically, if the student were to complete work via the internet outside the classroom (using speech perception-based exercises and receiving additional feedback), the issue of pronunciation instruction in the classroom, and in particular, the time-consuming, individualized attention necessary for such instruction would be diminished as a problem. This dissertation thus focuses on this central idea, improving L2
phonology outside the classroom, exposure to audible examples of the target language, metalinguistic explanation, and explicit instruction that play a role in the process of improvement of one’s L2 phonology.

1.2 The role of perceptual input in speech production

A considerable amount of research has proven that there exists a significant relationship between speech perception and speech production (Liberman et al., 1967; Liberman & Mattingly, 1985; Liberman & Mattingly, 1989; Fowler, 1986; Best, 1995). One such recent study by Rochet (1995) belongs to this body of literature that will be addressed in further detail in Chapter 2. Rochet showed that L1 speakers of Mandarin Chinese who were learning French as an L2 not only improved their perceptual abilities but also their production abilities by producing more native-like voice onset time (VOT) after simply receiving perceptual identification training.

There is also a literature (which will be addressed in more detail in the following chapter) from the field of speech pathology that argues for the perception/production link. For example, Rvachew (1994) showed that preschoolers with moderate phonological delay showed greater improvement in their production of the [ʃ] allophone after receiving perceptual input than the experimental groups who did not receive the perception. Given the empirical evidence that exists in the literature, the variable of speech perception (in the form of audible examples) in improving L2 phonology will be one of the several under investigation in the dissertation.
1.3 Specific aims and general experiment design

As briefly stated in the section 1.1, the principle aim of the dissertation is to confirm that second-language learners can improve their pronunciation in their L2 with the incorporation of computer-based exercises containing central factors in successful acquisition.

The dissertation is based on two consecutive studies carried out at the Pennsylvania State University during the semesters of Spring 2008 and Fall 2008. All participants were undergraduate students of Spanish 110 (Intermediate Spanish Conversation). The first study (henceforth Study 1) consisted of twelve participants, all from different sections. The participants were divided into three subjects groups: those participants who received both perceptual input and metalinguistic explanation (online) of the phonetic property (discussed in further detail in the following section) were labeled “Group A”; those participants who received only metalinguistic explanation were labeled “Group B”; and the control group was labeled “Group C”.

For eight weeks, Groups A & B completed weekly exercises on Pennsylvania State University’s online course management system ANGEL. Each weekly exercise consisted of approximately twenty multiple-choice questions, and participants were simply asked to identify a brief stream of speech sounds (not exceeding .25 seconds) as English (the participants’ L1) or Spanish (their L2). No exercise took longer than one-half hour to complete.

The second study (henceforth Study 2) was carried out the following semester, and was an expansion of the methodology of Study 1. In Study 1, factors under examination were exposure to audio-perceptual input and metalinguistic explanation. In Study 2,
another variable under investigation was exposure to explicit-training (herein ET) of the L2 pronunciation.

The two main characteristics of Study 2 that distinguish it from Study 1 are the number of participants (in Study 2, N=30), and the incorporation of ET. Furthermore, all participants were students from sections taught by one instructor. Again, participants were divided into three groups: “Group A” received ET in-class as well as perceptual input and metalinguistic feedback on the internet, “Group B” received ET in-class as well as computer delivered metalinguistic feedback, and “Group C” served as the control group.

As in Study 1, the participants of Study 2 completed weekly exercises for a period of two months. The ET was delivered in-class, for one period of fifteen minutes per week. Students were also given production exercises during these sessions. Students from Groups A & B came from one section, students from the other section served as the control group.

1.4 Phonetic property under investigation

It is not a surprising fact that English and Spanish, languages that belong to two separate language families (Germanic and Romance respectively), exhibit very different phonological processes (Comrie; 1990). A number of these phonological differences are challenging for L2 learners. One of these processes, /l/ velarization in the coda position of a syllable to the allophone [ɫ], as seen many varieties of English, (Giegerich, 1992; Ladefoged & Maddieson, 1996), is shown below. This process does not occur in contemporary Spanish, as there is no velarized lateral allophone.
Table 1-1: Allophonic distribution of [l] and [ɭ] in English

<table>
<thead>
<tr>
<th>Word</th>
<th>Allophone</th>
</tr>
</thead>
<tbody>
<tr>
<td>“fell”</td>
<td>[fɛɭ]</td>
</tr>
<tr>
<td>“feel”</td>
<td>[fiɭ]</td>
</tr>
<tr>
<td>“leaf”</td>
<td>[lif]</td>
</tr>
<tr>
<td>“let”</td>
<td>[lɛt]</td>
</tr>
</tbody>
</table>

From this data set we can see the general distribution of the two lateral phones. In the items “fell” and “feel”, we can see that the velarized allophone [ɭ] occurring in coda position of the syllable. However, when when /l/ is located in the onset of the syllable, seen in “leaf” and “let” velarization does not occur. In the study described below, I will focus on the issue of l-velarization in English learners of Spanish.

1.5 Organization of the dissertation

The remaining sections of the dissertation are organized as follows. Chapter 2 gives an overview of variables that are central in the acquisition of L2 phonology, with specific discussion on the types of feedback provided. In Chapter 3, I describe the experimental design as well as the participants, and the weekly computer-based exercises of Studies 1 and 2. The results and statistical analyses of Studies 1 and 2 are discussed in Chapters 4 and 5, respectively. Finally, Chapter 6 is comprised of the conclusion, discussing not only conclusive data but also remaining problems, and implications for future research.
Chapter 2

Forms of Feedback and Other Key Variables in Second-language Phonological Acquisition

2.1 Introduction

Since the latter half of the twentieth century, the study of second language acquisition (SLA) and its subsequent literature has emerged and grown at an exponential rate. Broadly speaking, SLA is a rapidly expanding field in which numerous theoretical approaches are brought to bear on the issue of the learning of a second language (or additional languages) at any given age under a variety of conditions. (Long, 2007:4). Researchers from fields such as linguistics, applied linguistics, psychology, anthropology, education, and SLA itself contribute to the growing body of work dedicated to this science.

The theories and findings are also utilized in other fields such as first language acquisition, theoretical linguistics, language processing, and language pedagogy. There are as many as sixty (Cook, 1993; Howatt, 1984; Lafford & Salaberry, 2003; Juffs, 1996; Long, 2007; Mitchell & Myles, 2004; Schumann, 1978; Van Patten & Williams, 2006) theories that are currently and readily referenced, including both original and modified
various theories on what it is the field of SLA attempts to accomplish, since Chomsky’s (1959) framework was introduced over fifty years ago.

The current chapter is divided into two main sections. The first is comprised of a brief overview of types of feedback that can be delivered to the second language learner, examining some specific examples of learning second-language sounds. The second section will address advancements made in the field of SLA specifically examining improvement in the production of L2 sounds, including discussion which examines research indicative of key factors in the improvement of L2 phones, such as exposure to audible input and metalinguistic explanation and explicit instruction / explicit training (herein referred to as ET).

2.2 Types of feedback in second-language learning

Generally speaking, when learning a first or a second-language, there are two types of feedback that the learner can receive; explicit and implicit (Birdsong, 1987; Carroll & Swain, 1993; Mackay et. al., 2000; Gass, 1997; Gass & Selinker, 2001; Swain & Lapkin, 1998). Before discussing at a more in-depth level the differences of these two types of feedback, it is necessary to note the differences between explicit/implicit knowledge and learning. Ellis and colleagues (2006) summarize the differences in the two types of knowledge and learning in a succinct manner. They state that explicit knowledge is what the individual is conscious of, while implicit knowledge encompasses what the individual intuitively knows. In a similar fashion, explicit learning involves the
learner receiving direct (linguistic) information on a given structure of a language.

Implicit learning is associated with the acquisition of the language in naturalistic conditions (Ellis et. at., 2006).

The notion of feedback is also viewed under the same manner, being explicit or implicit (Gass & Mackey, 2007). Explicit feedback incorporates specific information regarding the output produced by the learner, and there are two types. The first is utterance correction, where the learner is explicitly informed that their output is incorrect.

Table 2-1: Example of utterance correction/rejection

Nonnative speaker (NNS): un mesa.

\[
\text{a (masc. sing.) table.}
\]

Native speaker (NS): No. (Quieres decir) una mesa.

\[
\text{No. (You mean) a (fem. sing.) table.}
\]

The other type of explicit feedback is metalinguistic feedback, in which the NNS receive specific linguistic feedback as to why their output was incorrect.

Table 2-2: Example of metalinguistic feedback

NNS: un mesa.

NS: No. (Quieres decir) una mesa. Tienes el género incorrecto.

\[
\text{No. (You mean) a (fem. sing.) table. You have the incorrect gender.}
\]

Returning to the notion of improving L2 phonology using technology outside the classroom, we are able to note that both types of explicit feedback may be delivered to
the learner via the computer. If the learner is producing written (or oral) output, many software programs are able to at least provide output rejection. Some more advanced programs, such as that seen in Nagata & Swisher (1995, discussed in further detail later this chapter) are able to provide specific information to the learner about why their output was incorrect.

Pennsylvania State University’s online course management system ANGEL provides instructors the opportunity to create content, assignments, and quizzes. It is possible for an instructor to create a quiz online, and if the student’s output is simple (i.e. multiple choice, true/false, short answer, etc.), the feedback may be generated by the program for the student at the moment the quiz is submitted. This then takes the burden off of the instructor who would be responsible for grading written quizzes.

An instructor would also be able to provide metalinguistic feedback via ANGEL, but this is generally done by when the instructor access the material online alter student submissions, and grades each quiz individually. This is obviously more cumbersome for the instructor. Since the aim of this thesis is to provide evidence that technology can facilitate second-language learning, the tasks completed by the participants (discussed in detail in Chapter 3) provided only one form of explicit feedback; utterance rejection.

Tables 2-1 and 2-2 show us the two main forms of explicit feedback. The other type is implicit. Again, we can examine it in the same manner as we did with learning/knowledge. Implicit feedback involves cognitive strategies such as reasoning and negotiation on the part of the learner, who then have to respond. There are several
types of implicit feedback (Gass & Mackey, 2007). The first are confirmation checks, which tend to be expressions that assess if the utterance has been understood or not. An example can be seen below.

Table 2-3: Example of confirmation checks

\[ \text{NNS: un mesa.} \]
\[ \text{NS: Ah, una mesa. ¿Eso es lo que quieres decir?} \]
\[ \text{Ah. A (fem. sing.) table. Is that what you mean?} \]
\[ \text{NNS: Sí, una mesa.} \]
\[ \text{Yes, a table.} \]

The second type of implicit feedback is known as a clarification request. In this feedback the learner is pushed to produce clarification of the previous utterance.

Table 2-4: Example of clarification request

\[ \text{NNS: un mesa.} \]
\[ \text{NS: ¿Qué?} \]
\[ \text{What?} \]
\[ \text{NNS: una mesa.} \]

The third type of implicit feedback is delivered in the form of comprehension checks. These are used to assess if the student or interlocutor understood previously produced output, as can be seen below.
Table 2-5: Example of comprehension check

NS: Ésta es una mesa. ¿Entienden? ¿Necesitan que repita?

This is a table. Do you understand? Do you need me to repeat?

The final type of implicit feedback is known as recasting. A recast involves the reformation of incorrect output into correct input, which is then provided to the learner (Leeman, 2003).

Table 2-6: Example of recast

NNS: un mesa.

NS: Ah sí, una mesa. (nodding)

NNS: Sí, una mesa.

One of the characteristics shared by the four types of implicit feedback is that the native speaker, or instructor, must manipulate the output of the other interlocutor or of the student, and negotiation of meaning must take place on behalf of the instructor. As discussed with explicit feedback, this can also be provided with technology outside the classroom. However, since implicit feedback may involve the evaluation of the learner’s output in some detail (such as with recasts), this may pose a problem for the instructor. If the software or computer program cannot evaluate and provide the learner’s output in enough detail to provide implicit feedback, this then becomes the duty of the instructor.

The following studies of the dissertation involve implicit and explicit feedback. If we aim to show we can improve pronunciation outside the classroom at no expense to the
curriculum, it is counterintuitive to cause more work for the instructor. Thus the ensuing Study 1 involves only one form of explicit feedback, output rejection, when discussing the use of ANGEL. Study 2 addresses both explicit and implicit feedback, with the implicit feedback being delivered during the ET sessions in class.

2.3.1 Variables in improvement of L2 phonological production

There are an abundance of external facts or variables that facilitate the L2 acquisition process, and there exists a wealth of literature dedication to the examination of these variables. While age (Scovel, 1969, 1981, 1988; Schumann, 1975; Seliger, 1978; Krashen, Long & Scarcella, 1979; Flege, Munro & MacKay, 1995), gender (Wolfram, 1969; Asher & García, 1969; Suter, 1976; Elliot, 1995a), affect and attitude (Aronson, 1973; Harlow & Muyskens, 1994), and field (in)dependence (Witkin et. al., 1973; Jamieson, 1992; Elliot 1995b) are all well documented in the literature, perhaps one of the most provocative claims is that simply being exposed to perceptual input, i.e. hearing the L2 sounds, aids the improvement in the production of these sounds (Flege 1991).

2.3.2 Perceptual input

The relationship between speech perception and production has indeed been a long-standing topic in speech science. While some researchers argue that the two speech components are relatively independent of each other (Stevens & Blumstein, 1981; Diehl & Klunder, 1989), others (Liberman et. al., 1967, Liberman & Mattingly, 1989) claim
there exists a direct link, as listeners perceive phones as they would produce them themselves.

Empirical evidence of the latter notion is seen in several recent studies. Bradlow et. al. (1997) found that after significant perceptual training of the /l/--/r/ distinction to Japanese second language learners of English, more accurate target phones were not only perceived correctly but produced in a more target-like fashion as well. Their study consisted of 11 subjects, adult native speakers of Japanese at Doshisha University, Kyoto Japan. Subjects were recorded both before and after perceptual treatments, involving 45 sessions over a period of 3-4 weeks. The experiment consisted of a pretest, training or treatment, and a posttest. For speech perception participants simply had to choose the correct form presented to them. The tokens presented were minimal pairs containing the /r/ and /l/ in various positions (i.e. word initially, word finally, word initial consonant cluster, etc.). Participants were able to better perceive the problematic phones with better accuracy, and during the speech repetition task were rated as producing “better” phones by native American-English speaking judges.

Rochet (1995) also reported that speakers of Mandarin not only improved their perception of correct target French VOT after receiving perceptual identification training of [bu] and [pu] on a synthetic continuum, but their production yielded more target-like VOT’s. Similar findings were discovered by a study by Wang et. al. (2002), in which sixteen native speakers of American English were trained in the perception of 4 Mandarin tones over a two week period, again with pre- and posttests. Analysis of the data showed not only improvement in the learners’ perception of all 4 tones, but in their production as
well, without any type of production training. Furthermore, the improvement was extended to novel stimuli which was not used in the perception training. These results also indicate that the effect of training in perception transferred to the production domain.

There are also several useful findings within the field of speech-language pathology. The findings of Rvachew (1994), for example, support the hypothesis that perceptual input may be key in production, as it was noted that perception training aided in the sound perception of problem sounds (a series of several consonants) and in articulatory accuracy in children with phonological disabilities, compared to those subjects who received only traditional speech therapy.

Subjects consisted of 34 preschoolers with moderate or severe expressive phonological delays, all randomly assigned to the experimental (i.e. perceptual treatment in addition to regular speech therapy) group or the control group, which listened to computerized books. All underwent 16 treatment sessions (each consisting of 15 minutes) over a period of 6 months. The experimental group showed greater improvements in phonemic perception and articulatory accuracy compared to the control group.

Another fairly recent investigation carried out is Jamieson & Rvachew (1992). They also claim that phone identification can facilitate speech production for some children with delayed phonological skills. The study is similar to others in the field of speech-language pathology in which a decision-based task was used in speech perception with no sound production training being provided.
2.3.3 Metalinguistic explanation

Metalinguistic explanation, or information in the form of linguistic rules, is also another factor whose importance is debated in the literature. Some researchers such as Alenen (1995), DeKeyser (1995), Ellis (1993), Nagata (1993), Robinson (1996 & 1997) and all argue for the importance of metalinguistic explanation, while others such as Rosa and O’Neill (1999), Sanz and Morgan-Short (2003) and VanPatten and Oikkenon (1996) claim that metalinguistic explanation is not a valuable tool in L2 acquisition.

Alenen (1995) addresses the positive role of metalinguistic explanation with second-language learners of Finnish. Participants were divided into three experimental groups and a control group, and all groups read two passages for meaning. The first group read the passages with what were called enhanced passages, in which the target forms were italicized. The second group received explicit grammatical information in the form of rules, and then read an unenhanced passage. The third group received both explicit information and then read the enhanced passages. The fourth group served as the control. The results showed a beneficial impact on the L2 acquisition of the participants.

Ellis (1993) also addresses the positive role of metalinguistic explanation in the acquisition process. Participants were randomly assigned to four groups similar to those discussed by Alenen (1995). The first group received metalinguistic explanation of the phenomenon known as soft mutation in Welsh. The second group received metalinguistic explanation as well as examples. The final two groups were not exposed to either form of input. Results indicated that metalinguistic explanation does aid in L2
acquisition, but the combination of explanation and examples helps the learner even more.

Finally, Robinson (1996) also examined the variable of metalinguistic explanation, in the form of presentation of linguistic rules. Participants were L1 speakers of Japanese, and were divided into four groups, and were presented explicit rules on simple and advanced English morphosyntax. The first group, the implicit group, was required to memorize each sentence that was presented. The second group was called the incidental group, and was required to read the sentences for meaning. The third group was asked to identify the rules of the sentences, and the fourth group received explanation on the grammatical rules and was also exposed example sentences. For the simple rules, the fourth group did better than all other groups on the grammaticality judgment task. For the advanced structure, the fourth group did not do as well. Robinson interprets the results as metalinguistic explanation being more beneficial than implicit learning.

As with other areas of SLA, there is counterevidence against the role of metalinguistic explanation. VanPatten and Oikkenon (1996) claim there is no beneficial role of metalinguistic explanation in the acquisition process when the learner is provided with structured input activities. However, they are presented with implicit knowledge, and the study concentrated on the acquisition of L2 morphosyntax, not L2 phonology.

In an intriguing article by Nagata and Swisher (1995), metalinguistic explanation and feedback is delivered to the learner by means of computer. Compared to a group L2 Japanese learners that received simple feedback on their output, the group that received
enhanced feedback using a computer program on the Japanese passive structure produced fewer grammatical errors. The participants were divided into two groups; one received simple feedback on their production of Japanese sentences when constructing them using a computer program, the other received specific information regarding the syntactic and morphological errors made. Improvements made by the latter group indicated that metalinguistic explanation plays an important role in drawing attention to areas of difficulty when learning a new structure.

2.3.4 Explicit Instruction (ET)

The final variable under investigation in the ensuing studies is ET in the process of language acquisition. Recently and specifically, Lord (2005) examined the effects of a ‘Spanish phonetics’ course at the university level. Several specific phonological properties of Spanish were presented to 17 participants. Results showed that the participants receiving the explicit instruction improved their production of target phones.

Yoshimi (2001) also examines ET and communicative practice in the acquisition of Japanese discourse markers. The group that received ET did show improvement in their L2 production, further lending support to the notion the ET aids the SLA process.
2.4 Conclusion

The following chapter of the thesis discusses the design of the current studies, which take into account the role of factors of audible input, metalinguistic explanation, and explicit feedback provided to the learner via computer software outside of the classroom. The variable of implicit feedback will be manipulated with those groups receiving ET. Potential implications are great, as if improvements in L2 abilities occur, experimental treatments (to be shortly discussed) may be implemented without sacrificing already limited class time to the discussion of pronunciation.
Chapter 3

Experiment design and methods of Studies 1 and 2

3.1 Introduction

In the experiments that will be discussed in further detail this chapter, the methodology of the two was quite similar. Study 2 is a modified and expanded version of Study 1. Both aim to test the effectiveness of the online tasks on the speaker’s L2 phonology, and focus on the lack of [l] coda velarization in Spanish (discussed in section 3.3). That is, both focus on the challenge that L1 English speakers face in mastering the target pronunciation of Spanish [l] in contexts that would trigger a rule of velarization in English phonology. Based on evidence presented in Chapter 2, we predict a decrease in velarization of the L2 learners’ Spanish lateral allophone, simply as a function of receiving audible examples and other types of feedback via a computer software program at home.

In Study 1, all twelve participants (n=12) were tested in a linguistics laboratory at the Pennsylvania State University, University Park, at the beginning of the Spring 2008 semester (this meeting will henceforth be referred to as the ‘pretest’) and once again during the final weeks of the semester (henceforth called the ‘posttest’). In Study 2, all participants (n=40) came to a different linguistics laboratory for the pre- and posttests. In
both studies during the pretest, participants completed necessary IRB paperwork and completed a two-block word-naming task (summarized below) in Spanish which was digitally recorded\footnote{See Appendices A - C}. All participants were compensated, in accordance with IRB approval, by receiving 5% points on their final grade for their Spanish 110 course.

\textbf{Table 3-1: Blocks of pretest (and posttest)}

Block 1: 50 item word-naming task (primer, tokens not included in analyses)

Block 2: 110 item word-naming task

The first block of the Pretest consisted of fifty words, presented in a randomized order using Eprime © software (Psychology Software Tools, Inc., 2010). The fifty tokens were recorded, but none was measured in this block, as it served to prime the students for the following block. All words can be seen in Appendix C, with 50 random words being taken from the list for the first block. Then, all were used in the second block, repeating some of the words named in the first block.

No block was self-paced. After the direction appeared on the screen, students were prompted to hit the space-bar to continue to the block. After the block was started, an item would appear on the center of the screen for three seconds, at which time the participants were instructed to simply utter the item into the microphone. Items remained on the screen for three seconds due to the fact that the tasks were not self-paced.

The second block consisted of a longer word-naming task, using all of the tokens from Appendix C in a randomized order, and all items were digitally recorded.
An example of the target utterances of this block can be seen below, which is followed by a short summary of the blocks.

**Table 3-2: Example of sequence of utterances of word-naming task(s)**

1. Computer screen reads: **papel**
2. Participant produces: [papel]
3. Computer screen reads: **sol**
4. Participant produces: [sol]

### 3.2.1 Participants and subject groups of Study 1

All participants were students of Spanish 110 (Intermediate Conversation) at Penn State University Park, Spring semester 2008. Although the course is titled to be at the intermediate level, most students are coming directly from the Basic Language Program and have relatively low proficiency compared to advanced learners. Potential participants (students of every section of Spanish 110 that semester) received a recruitment email from their respective instructors once at the beginning of the semester. A total of twelve (n=12) participants, nine females and three male, all of ages 18-22, participated in the experiment. As determined by the completed Language History Questionnaire and Pronunciation Attitude Inventory, all participants were L1 speakers of English with Spanish as the only L2. (To better control for vocabulary abilities in Spanish, participants were also given the Boston Naming Task\(^2\) in Study 2.)

The participants were randomly assigned to one of three groups, with each group containing 4 participants (N=4). Before completing the weekly perceptual-based treatments, each group was provided with a different amount of information on

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\(^2\) See Appendix D
velarization on ANGEL, the online course management system at Penn State University. The first group (Group A) was given audible examples and also metalinguistic explanation of the /l/ velarization difference seen between English and Spanish. The second group (Group B) was only given metalinguistic explanation of the process, and the third (Group C) served as the control group and was given no specific information on l-velarization.

Group C was provided with short listening comprehension exercises that consisted of a short passage (read at a moderate speaking rate by a native speaker of the peninsular variety of Spanish)\(^3\). The groups (and thus factors under examination that may play a role in attainment of L2 phonology) are summarized in the following table:

**Table 3-3: Subject Groups of Study 1**

- Group A: Audible examples and metalinguistic explanation
- Group B: Metalinguistic explanation
- Group C: Control Group

**3.2.2 Participants and subject groups of Study 2**

As in Study 1 all of the participants in Study 2 were students of Spanish 110, but in this case were recruited during the following semester, Fall 2008. By contrast with Study 1, in Study 2 all participants were students of sections taught by the author. In order to have a maximal number of participants (n=30), “Participation in a Research Study” was made a requirement (with IRB approval) of the course and carried a weight of 10% on the final grade. Students did have the option to not participate and see three

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\(^3\) See Appendices E - F
movies (to be approved by the instructor) and write corresponding reaction papers to earn the 10%. All students opted to participate in the study.

In Study 2, another factor under examination in successful attainment of more ‘native-like’ production of L2 phones was Explicit Instruction (ET), with implicit feedback being delivered in class. Again, students were randomly assigned to one of three groups. Group A received ET on differences of velarization between English and Spanish, lasting approximately 15 minutes, one class period a week. This was supplemented with perceptual input and metalinguistic explanation online. Group B received ET, with only metalinguistic explanation provided online, and Group C served at the control group. Furthermore, to successfully have ET excluded from the activities of the control group, all of the participants from Group C came from one section (in which there was no ET), and the remaining participants were assigned to Groups A and B. A summary of the groups and the number of subjects can be seen below. We also note the increase in participants, with a total of (N=30).

**Table 3-4: Subject Groups of Study 2**

Group A: ET, audible input and metalinguistic explanation (n=12)

Group B: ET and metalinguistic explanation (n=13)

Group C: Control Group (n=15)

As previously mentioned, all participants in Study 2 completed the Boston Naming Task (Kaplan et. al., 1983), to further determine their lexical ability in Spanish. The mean score of Group A was a mean score of 3.56 / 60, the score of Group B was 4.37 / 60, and the score of Group C was 4.06 / 60. No ANCOVA’s or statistical analyses
were carried out, as no participant scored better than 7 items correct. As can be seen by these extremely low scores on the Boston Naming Task in Spanish, the level of vocabulary for these students indexes a low level of proficiency in Spanish and thus arguably these students are a good group for testing for the efficacy phonological training at an early stage of Spanish acquisition.

As previously stated, in Study 2 participants received additional ET. This instruction was completed in class every Friday for approximately 15 minutes (see Appendix H for sample Powerpoint presentation), and was given during the same weeks that students were completing the online. During the in-class ET, students received short pronunciation training, in which they practiced and repeated target words, in unison as a class. The syllabus used for Spanish 110 did not have to be altered to include the ET.

3.3 Differences in coda velarization in English and Spanish

In these studies I specifically examine the differences in velarization of coda laterals, a phonological process observed in English but not in Spanish (Giegerich, 1992; Ladefoged, 1979, 2001 & 2003; and Ladefoged & Maddieson, 1996). Velarization, the process in which there is a raising of the dorsum of the tongue during the articulation of a consonant or vowel, is a phenomenon seen in many languages. This occurs in languages such as English, in which the lateral [l] allophone (which corresponds with the phoneme /l/) is realized as the velarized [ɫ] when in the coda position of a syllable (Ladefoged & Maddison 1996:360, Giegerich 1992:29). For the majority of languages in which this phonological process is absent, one would expect a second-language learner of any of
these languages to have some difficulty upon producing a velarized allophone, and this is clearly the case for English learners of Spanish.

Spanish belongs to the group of languages in which there is no velarization of the lateral phoneme in any phonological context (Harris, 1969:18; Núñez Cedeño & Morales-Front 1999:37). The absence of the velarized lateral allophone in the speaker’s L1 phonology may pose problems when introducing the speaker to the phone in speech perception and production, especially at the elementary level of language instruction. Furthermore, SLA research has long recognized the importance of L1 phonological transfer in the interlanguage of second language learners and bilinguals (Nemser, 1971; Corder, 1971, & Selinker, 1972). However, results of some specific research on the acquisition of these phones may yield further insight into the acquisition of the L2 phones and explicit rules necessary to produce them and thus may have direct relevance in SLA as well as the pedagogy of accent reduction and approximation of L2 phonological norms. More specifically, although L1 phonological transfer may play a role in hindering the mastering of L2 phonetic targets, the goal of this study is to test for whether the effects of L1 transfer can be ameliorated via computer-based training outside of the classroom.

3.4 Acoustic characteristics of [l] and [ɬ]

As previously stated, lateral velarization is described as a process in which the lateral approximant /l/, often referred to as ‘clear [l]’ in the literature (Sproat & Fujimura, 1993), becomes velarized in a given context. During this process, the dorsum of the tongue ascends toward the soft palate, or velum, and the velum slightly descends toward
the tongue body, rendering a velarized or ‘dark [ɾ]’. In English, the clear variant is found syllable initially, and the velarized variant syllable finally. To accurately detect the degree of velarization of a consonant has become increasingly easier since the latter half of the twentieth century due to developments in acoustic analysis technology. With such advancements as voice and digital recordings, palatography, still and video photography, air pressure and airflow recordings and more advanced acoustic analyses, the ability to analyze sound variations quantitatively that may, in some cases, not be easily noticeable to the ear has become more accessible than ever. In the analyses that examine lateral velarization and the degree thereof, the primary measure of velarization involves using spectral analyses.

Spectral analyses of speech describe the frequency and intensity of all sinusoidal components of the speech wave (Denes & Pinson, 1993). In such an analysis the effects of all of the speech sounds are combined, and then the summed energy is plotted. The variations over time are clearly visible and thus, more easily identifiable. A considerable amount of spectral information is available about individual speech sounds (apart from other speech characteristics such as pitch, amplitude, etc.), especially for vowels. The most significant spectral features for vowel-like phones are the frequencies and amplitudes of the various formants. Vowels, like other speech sounds, are characterized by the vocal tract resonances (known as formants) in the vocal tract\(^4\). These resonant frequencies change as we modify the shape of our vocal tract to articulate different speech sounds. Since it has been well established that vowels are the most resonant of speech sounds, intuitively we can expect vowels on a spectrogram to have the most

\(^4\) Since the current study focuses on acquisition of allophonic variation in Spanish, I will only discuss the formant structures of the five vowel [i, e, a, o, u] Spanish vowel system for the sake of simplicity, as opposed to discussing the formant structures of the thirteen vowels present in English.
visible formants. The first formant (known as F1) is the resonance with the lowest frequency, and generally indexes vowel height. Specifically, the higher the F1, the lower the vowel. Thus, the vowel [a], the lowest vowel, tends to have a higher F1. Vowels in which there is less resonance during articulation, such as the mid vowels [e, o], have a lower F1 than [a], and [i, u] have even lower F1’s than the mid vowels.

Generally speaking, the second formant (F2) corresponds with the resonance that occurs in the back of the mouth. Thus, [u] tends to have the lowest F2, as the dorsum of the tongue tends to be closest to the back of the mouth (compared with the other four vowels). Thus, the vowels [o, a, e, i] have respectively increasing F2’s, as upon articulating these four vowels (in this order) the body of the tongue moves closer to the front of the mouth, causing a larger resonating chamber at the back of the mouth.

Returning to the notion of vowels being the speech sounds that are the most resonant (and thus the sounds most likely to have the clearest, most identifiable formant structure) we also know that there are other sounds that are more sonorant than obstruents, such as nasals, liquids and glides. Ladefoged (1979) shows that nasals and liquids also have their own formant structures similar to those seen in vowels, along with glides (although formant structure usually changes drastically compared to monophthongal vowels and other sonorant sounds during the articulation process).

As previously stated, vowels and other sonorants are the speech sounds that show the clearest formant structure when examining a spectrogram. Let us return to the discussion of the lateral allophones [l, ɾ] in English. We know now that laterals do indeed have their own distinct formant structures. Ladefoged (2003:146) shows that both onset and coda position in laterals do indeed differ in F2, which is comparatively high for
the onset lateral (around 1200 Hz), and lower for the velarized coda (about 800 Hz). We would expect this drop in F2 for the coda laterals, as velarized sounds involve a slight lowering of the velum, which decreases the size of the resonating chamber in the back of the mouth (as previously discussed). The difference in F2 frequencies between the velarized and nonvelarized laterals can be seen below.

**Figure 3-1: Spectrogram of the Spanish word ‘difícil’**
Figure 3-2: Spectrogram of the English word ‘meal’

As we can see in the preceding figures, we have the spectra of the Spanish word ‘difícil’ and below we have the English word ‘meal’. The two words are different with respect to the velarization of the /l/ allophone, but we not that the –l- is in the coda position in both examples. In English the coda [l] is velarized in English while in Spanish it is not. In the spectrogram for ‘meal’, in which we have the lateral consonant in the coda position, we can see the F2 frequency is relatively low, around 800Hz (indicated by the “bull’s-eye” symbol. However, in the word ‘difícil’, in which the lateral phone is still in the coda position, we see a rather high F2 of about 1200Hz. This difference is significant, and with these examples we are able to clearly see the difference in velarization by look at the F2 frequency.

We have noted above that velarization can indeed be noted by examining the F2 of the consonant in question. However, there also is a substantial body of literature
which supports that both F1 and F2 frequencies yield a more accurate measurement of degree of velarization of the lateral (as will be discussed in the last chapter).

3.5 Pretest

As briefly mentioned in section 3.1, participants from Study 1 and Study 2 came to their respective labs, at the beginning of the studies, where necessary IRB paperwork, language history questionnaires, and Pronunciation Attitude Inventories were completed. Study 2 participants also completed the Boston Naming Task.

Following the paperwork all participants completed the Pretest (identical in both studies) that consisted of a simple word-naming task containing three blocks. Items from the word naming task can be found on Appendix C.

3.6 Method of online testing

All participants took an initial ‘Perception Pretest’ on ANGEL, Penn State's online course management software system (similar to ‘Blackboard’ at other institutions), before beginning the first week’s assignment. During the course of the semester, Groups A and B were provided one exercise per week, for a period of eight weeks, on ANGEL.

Each exercise consisted of twenty questions. Each question contained a .wav file, and the participant simply was asked to identify the stream of speech sounds as sounding ‘English’ or ‘Spanish’ (see Appendix G). For each weekly treatment, students had one hour to complete all the questions. They were able to listen to all tokens an unlimited number of times in that one-hour period. The stimuli were prepared by phonetically cutting items produced by a highly proficient English-Spanish bilingual who read items
from a word list in English and a separate list in Spanish. The Spanish words were read first and recorded, and after a break of a few minutes the bilingual read the English items. Items in English were generally paired with Spanish items that had similar phonetic sequences. For example, the English word ‘coal’ [kʰɔʊl] and the Spanish word ‘col’ [kol]. Praat was used to cut the word initial plosive (and aspiration if needed) with the aim of presenting the participant with the phonetic sequences [ɔʊl] / [ɔɬ] and [ol]. The participant then simply decided if the presented sequence of sounds was English (by choosing ‘inglés’) or Spanish (español) in the weekly treatment.

At the end of the eight week period, all participants were asked to take a ‘Perception Posttest’, also accessed on ANGEL. The perceptual pretests and posttests were identical, but the questions were randomized.

### 3.7 Posttest

At the end of the eight-week period, all participants returned to the lab. Participants then completed the same three-block task seen in Table 3-1. Participants were then debriefed on the true purpose of the studies.

### 3.8 Method of assessment

The recordings of the Pretest blocks and the Posttest blocks were analyzed using Praat Phonetics Software ©. The F2 value of the [1] sound of each token was recorded, then compared and statistically analyzed. The tokens were coded if they were cognates, words with the prefix –alc (a prefix common in Spanish, Penny, 2002)), and also if they were nonce words. Based on previous research, we expect to see decreased velarization
of the allophone [l] in the coda position in groups that received training. The results of speech perception and the statistical ANCOVA analyses of speech production of the participants are discussed further in Chapters 4 and 5.
Chapter 4

Results of Study 1

4.1 Introduction

In contrast to English, /l/ coda velarization does not occur in Spanish. As noted in Chapter 3, velarized /l/s tend to have a lower F2 frequency of approximately 800 Hz whereas non-velarized laterals tend of have a higher F2 of about 1200 (Ladefoged, 2003:146). The aim of the experiment was to test whether the effects of perception and metalinguistic explanation regarding the lack of velarization in Spanish, via ANGEL exercises at home, could improve the participants’ L2 speech production. If so, the pedagogical advantage to this approach is that instructors can spend limited class-time on other parts of language learning, while still incorporating material that will serve to enhance the development of target-like pronunciation in the L2.

4.2 Participants & results of weekly perception tasks

Participants were randomly assigned to three treatment groups (four students in each group). The first group received audible examples lasting approximately .25 seconds and metalinguistic explanation. The second group received only metalinguistic explanation and the third group was the control group (see Appendices E, F, & G). The following show the summary
of the subject groups, along with the results of the weekly perception tasks that were completed on ANGEL.

**Table 4-1: Subject Groups**

Group A: Audible input and metalinguistic explanation (n=4)

Group B: Metalinguistic Explanation (n=4)

Group C: Control Group (n=4)

**Figure 4-1: Weekly treatment scores of Group A**

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1 Series = participant
Figure 4-2: Weekly treatment scores of Group B

Figure 4-3: Weekly treatment scores of Group C
In figure 4-1, we can see that there is an improvement in perceptual ability of the participants immediately after the first treatment. Two subjects had a score of 60% on the pretest, and two had scores of 80%. We note that all four subjects score between 80% and 100% the first week, after only one treatment. By week three, we also see that all participants scored 100%, and all scores remain between 80% and 100% for the rest of the treatment sessions. This performance is compatible with the hypothesis that the treatment yielded immediate results with this group, confirming the roles of audible input and metalinguistic explanation in developing the L2 sound system.

In figure 4-2, we can see that Group B participants (who received only metalinguistic explanation) also improved their L2 perceptual abilities, but not (descriptively) to the extent that Group A did. During the pretests we can note that the scores range from 50% to 80%, and although one participant does score 100% after the first treatment, the remaining scores range between 70% and 50%. By week 4 all scores are at 80% or better, and although one participant scores a 70% during week 7, the other subjects continue to score 80% and above from week 4 on. This indicates that metalinguistic explanation alone may be an important variable in the ability to perceive L2 sounds.

Figure 4-3 shows us the performance of the control group, who did not receive any perceptual input nor metalinguistic explanation of velarized phones. We see that there is improvement between week 1 and week 8, but nowhere as drastic as with Groups A & B, confirming the beneficial roles of audible input and explanation in L2 perception.
4.3 Exploratory L2 production data analysis

The production data was analyzed in SAS (Littell et al., 2006). As previously discussed in Chapter 3, twelve students from Spanish 110 (Intermediate Conversation) participated in the first study conducted in the spring semester of 2008. Before the treatment, students had to complete a pretest consisting of two sessions. In the first session, they had a 110 word naming task serving as a primer, and in the second session the students had the same 110 words. The words used in these two sessions were the same and they appeared randomly on the screen of the computer.

The F2 frequency of the “l” sound was recorded for each word for every student. The data set also provides information on whether the Spanish word is a cognate or if it contains the letter combination “alC” in its structure.

The reason for choosing words with the initial [alC] cluster\(^2\) is a historical one. Penny (2002:65) points out that from the 700s to the 1400s, Arabic was the official language of a substantial area of the (Iberian) Peninsula. He goes to note that a very high percentage of Arabisms in Spanish are nouns. The majority of these nouns contain the initial cluster of phones [alC], because the Arabic definite marker [al] was reanalyzed by speakers of this hispanoromance dialect as part of the actual noun base. Since there are a high number of nouns in Spanish that begin with this cluster, for exploratory purposes, it seemed useful to isolate it as a variable. If pronunciation were different in words containing these clusters, that might be attributable to the presence of this cluster. Anticipating the results of this study, I found no differential patterning of “alc” words, and as a consequence, the “alc” variable was not employed in the statistical analysis of Study 2.

\(^2\) “C” equals any consonant.
The treatment was applied every week for an eight-week time period, at home using ANGEL, and consisted of explicit feedback on multiple choice questions (see Appendices E through G). After the treatment period, students completed a posttest that was identical to the pretest. For the pretest and posttest, the same Spanish words were used but in a random order.

Table 4-2 reiterates the blocks of the speech production pre- and posttests, accompanied by the following figures which show us the mean F2 values of the pre- and posttests of the different subject groups.

**Table 4-2: Blocks of pretest (and posttest)**

Block 1: 50 item word-naming task (practice block, tokens not included in analyses)

Block 2: 110 item word-naming task

Figures 4-4 through 4-6 show us the speech production scores (i.e. the mean F2 value of the lateral allophones of the recorded tokens) of each subject group. We notice in the first column of 4-4 that Group A (those who received both audible input and metalinguistic explanation) produced unvelarized phones with a mean F2 of over 1000 Hz (i.e. more toward the native Spanish norm) during the pretest, before completing the first treatment. We see that the production of the [l] allophone is more like the Spanish norm, with a mean F2 above 1300 Hz during the posttest.
Figure 4-5 shows us the F2 values of the speech production task of Group B. The first column reports a mean F2 of 850 Hz for the blocks of the pretest, and a mean F2 of approximately 1000 Hz for the post-test, thus a decrease in velarization and improvement toward L2 production norm. Figure 4-6 shows us the performance of the control group, whose mean F2 values were already rather high during the pretest, approximately between 1420 Hz (first column), and relatively little change in the posttest values (second column).
**Figure 4-5:** Group B speech production scores

**GROUP B**

<table>
<thead>
<tr>
<th>Hz</th>
<th>PRE F2</th>
<th>POST F2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>850.5</td>
<td>1008.4</td>
</tr>
</tbody>
</table>

**Figure 4-6:** Group C speech production scores

**GROUP C**

<table>
<thead>
<tr>
<th>Hz</th>
<th>PRE F2</th>
<th>POST F2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1418.7</td>
<td>1425.7</td>
</tr>
</tbody>
</table>
4.4 Analysis of Covariance (ANCOVA) using SAS 9.2

In this section I will address the statistical analysis of the speech production of the three subject groups. In the first study, for every participant F2 frequencies were recorded for all target items, which were additionally coded for targets that were cognates and for targets that begin with the letters “alc.” If, for every student, all the measurements for the cognate were treated as independent observations and all the measurements for the “alc” words as additional independent observations, then this would be considered pseudo-replication. The repeated measurements on cognate words on each student are not independent. An identical situation occurs with the “alc” words. A good way to avoid this pseudo-replication is to take averages for the recorded F2 frequencies for four different categories of words: (cognate, alc), (cognate, non-alc), (non-cognate, alc), and (non-cognate, non-alc).

As mentioned above, the list of tokens contains items with the initial cluster [alC], and each token was coded as to whether it was a cognate or not. The identification of whether each item was a cognate or not was important, given that if target-like pronunciation occurred in the all L2 tokens (cognates or not), the data would then suggest that the learners are internalizing the L2 phonology and there is indeed a link with the domains of perception and production, as noted by Rochet in (1995). If a word is a cognate, there exists the possibility that the L2 speaker may produce the target word using their L1 phonological system.

The experimental unit for instruction treatments is the groups; the study is also interested in whether word class affects the subjects’ pronunciation. Thus, word class (cognates/non-cognates) is considered the treatment associated with experimental units at the subject level. The
participants in a particular group only received one treatment so the subjects are nested in that
group (treatment). This experiment involved two sizes of experimental units: (1) the group to
which the instructions were applied and (2) the subject nested with group. The covariate, pre-test
frequency, is measured on each subject, which is the small-size experimental unit. For this
experiment it is best to use the analysis of covariance (ANCOVA, Kuehl, 2000; Montgomery,
1999; Ott & Longnecker, 2001). ANCOVA is a combination of ANOVA and regression for
continuous variables, which tests whether certain factors (instruction type and word class in this
case) have an effect on the response variable (frequency difference) after removing the variance
for which quantitative predictors (covariates, pre-test score) account. The analysis of variance
table displays quantities that measure how much of the variability in the response variable is
explained and how much is not explained by the factors.

As previously stated, ANCOVA models combine ideas from analysis of variance
(ANOVA) models and regression. To use the ANCOVA model, we need to identify the response
variable, the factors and the covariate. The role of the covariate is to adjust for initial differences
between the treatment groups. By adding the covariate, we can be more confident that the
treatment effect is due to the applied treatment and not to some variability between the groups. In
this case, the covariate is the pretest F2 frequency or the pre test arithmetic task F2 frequency.
The factors are the treatment, cognate and “alc.”

There are also two response variables in the study: (1) the difference between posttest and
pretest F2 frequencies (difference1) and (2) the difference between the post test arithmetic and
pre test arithmetic F2 frequencies (difference2). Because of this two models must be built. The
first model has the response variable “difference1,” the factors treatment, cognate and “alc,” and
the covariate is pre test F2 frequency. The second model has the response variable “difference2,” the factors treatment, cognate and “alc,” and the covariate is pre test arithmetic F2 frequency.

As part of the exploratory data analysis, a correlation procedure was run to investigate the relationship between the response variable “av_difference1” (average difference between the pre and posttest), and the covariate “av_pre” (average frequency of the pretest). The following output (Table 4-3) shows that the correlation between the response variable and the covariate is -0.6907 (p>α; α = 0.05). Since the p-value for the correlation procedure is less than 0.05 (p <0.0001), we can conclude that there is a strong relationship between the response variable and the “av_pre”. This result supports the decision of considering the “av_pre” variable as a covariate.

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>Mean</th>
<th>Std Dev</th>
<th>Sum</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>av_pre</td>
<td>48</td>
<td>1100</td>
<td>347.48729</td>
<td>52806</td>
<td>399.51333</td>
<td>1665</td>
</tr>
<tr>
<td>av_difference1</td>
<td>48</td>
<td>141.17877</td>
<td>272.54435</td>
<td>6777</td>
<td>-344.05000</td>
<td>1056</td>
</tr>
</tbody>
</table>

Pearson Correlation Coefficients, N = 48
Prob > |r| under H0: Rho=0

<table>
<thead>
<tr>
<th></th>
<th>av_pre</th>
<th>av_difference1</th>
</tr>
</thead>
<tbody>
<tr>
<td>av_pre</td>
<td>1.00000</td>
<td><strong>-0.69070</strong></td>
</tr>
<tr>
<td>av_difference1</td>
<td><strong>-0.69070</strong></td>
<td>1.00000</td>
</tr>
</tbody>
</table>

**Table 4-3: Correlation Procedure**
To further investigate the data set, we will plot the box plot of response variable by treatment group. Before doing that, we need to sort the data set by the variable of subject groups ("treat).

**Figure 4-7: Box plot of average difference of F2 frequency by treatment group**

Figure 4-7 suggests that the means and the variances of the average difference between the pre and posttest variable are very different between the treatment groups. Also the response range for treatment A is wider compared to treatment B and C. There is a lower variability in the response values for students who received treatment B comparing to students who received treatment A and C. Note that the response values for treatment B are all positive.
As previously stated, ANCOVA models combine ideas from analysis of variance (ANOVA) models and regression. The ANCOVA analysis yielded the following results.

### Table 4-4: ANCOVA Type 3 Tests of Fixed Effects

<table>
<thead>
<tr>
<th>Effect</th>
<th>Num DF</th>
<th>Den DF</th>
<th>F Value</th>
<th>Pr &gt; F</th>
</tr>
</thead>
<tbody>
<tr>
<td>treat</td>
<td>2</td>
<td>27.3</td>
<td>0.51</td>
<td>0.6067</td>
</tr>
<tr>
<td>cognate</td>
<td>1</td>
<td>21.9</td>
<td>1.49</td>
<td>0.2353</td>
</tr>
<tr>
<td>av_pre</td>
<td>1</td>
<td>22.7</td>
<td>15.18</td>
<td>0.0007</td>
</tr>
<tr>
<td>a1C</td>
<td>1</td>
<td>22.3</td>
<td>0.01</td>
<td>0.9134</td>
</tr>
<tr>
<td>treat*cognate</td>
<td>2</td>
<td>21.8</td>
<td>2.08</td>
<td>0.1491</td>
</tr>
<tr>
<td>av_pre*treat</td>
<td>2</td>
<td>26</td>
<td>0.37</td>
<td>0.6977</td>
</tr>
<tr>
<td>treat*a1C</td>
<td>2</td>
<td>22</td>
<td>4.58</td>
<td>0.0218</td>
</tr>
<tr>
<td>cognate*a1C</td>
<td>1</td>
<td>21.7</td>
<td>1.72</td>
<td>0.2033</td>
</tr>
<tr>
<td>av_pre*a1C</td>
<td>1</td>
<td>22.4</td>
<td>0.01</td>
<td>0.9137</td>
</tr>
<tr>
<td>treat<em>cognate</em>a1C</td>
<td>2</td>
<td>21.7</td>
<td>1.99</td>
<td>0.1607</td>
</tr>
<tr>
<td>av_pre<em>treat</em>a1C</td>
<td>2</td>
<td>22.1</td>
<td>3.79</td>
<td>0.0384</td>
</tr>
</tbody>
</table>

I consider that a term in my final model is significant if it has a p-value less than 0.05 (this is called the significance level). Since we have to run two ANCOVA models (the first model is the one that has the response variable “difference1” (the difference between posttest and pretest F2 frequencies) and the second model is the one that has the response variable “difference2” (the difference between the post test arithmetic and pre test arithmetic F2 frequencies)) on the same data set, the Bonferroni correction must be applied (Kuehl, R.O., 2000), therefore $\alpha = .025$.

However, this was not expected. Even though the token list was coded is a word was composed of an initial [al]C cluster or not, there was not an equal amount of tokens.
Lengthening the token list and still observing such an interaction might lead us to further examine it, but the token list was kept at specific length, before the conclusion in this chapter.

A good way to see the relationship between the interaction factor “treat*alc” on the response variable, taking into account different values of the covariate, is to draw a plot with the estimated regression lines. By looking at the table in 4-4, we notice there is a significant interaction between the treatment types and the [alC] variable. A useful way to understand this interaction is to plot the regression plots for the different groups.

**Figure 4-8:** Estimated Regression lines for six different groups
In Figure 4-8 we notice that as the pretest scores increase (that is, if a participant produced an [l] with a high F2 frequency during the pretest), the difference between the pretest and posttest scores would decrease, and this happens in all groups. We would expect this; if a participant initially produces the lateral allophone with a high F2, the difference between the pretest and posttest would be less, since the target F2 frequency is higher than that of the L1.

We can see that the regression lines for treatment B+alc and treatment B+non-alc are almost the same. That is, whether the word contained an [lC] cluster did not seem to be significant for Group B. We can also observe that treatment A+non-alc had a better effect than treatment A+alc when the covariate was at the lower levels. All regression lines indicate a better effect of the treatment at the minimum value of the covariate. However, we can not yet determine what this interaction means. Initially, we coded tokens if they were [al]C constructions, but we can note from Appendix C there isn’t an equal number of [al]C and non [al]C tokens. For this reason we will not include it in the analysis in Study 2. Lengthening the token list would possibly cause the pretest word-naming block completed at the beginning of the study. We also see that the number of participants was doubled, and having each participant complete the lab pretest in an expeditious manner as this study is pedagogical in nature and framed around the schedule of an academic semester. However, it is undeniably something that would benefit from further examination in future studies.
4.5 Conclusion

This chapter examined the difference in speech perception and production abilities by the three different subject groups. As mentioned in previous chapter, the primary goal of this thesis is to examine the role of certain factors (audible input and metalinguistic explanation) of target L2 pronunciation, specifically discussing the lack of velarization of the Spanish /l/.

There were three subject groups in this Study, each being exposed to the aforementioned factors differently (see table 4-1). When compared to the control group, we observed that the two groups who were exposed to these factors showed improvement in both perception and production of target T2 phones. However, the results may not have yielded exactly what was expected. Addressing the notion of speech production, Group A (who received audible examples alone) did improve, but they also were producing more target-like phones during the pretest. Group B received metalinguistic explanation, and showed improvement as participants produced L1-like phones during the pretest and more target-like phones in the posttest. Both groups improved significantly more than the control group, who only completed listening comprehension exercises on ANGEL (see Appendix F).

Turning to the speech perception data seen in figures 4-1 through 4-3, for both Groups A and B we see drastic improvement after completing the first treatment compared to the control group, and continue to improve throughout the course of the study.

However, the perhaps most noticeable characteristic of the study is the low number of participants (N=12). We would undoubtedly be able to strengthen the claims of the study if it were increased substantially. We also saw the curious results in speech production of Group A (figure 4-4), in which we see target-like pronunciation during the pretest, and target pronunciation during the posttest, which was unexpected. This indicates something that needs to
be addressed in a follow-up study, and possibly may be remedied by increasing the number of participants.
Chapter 5

Results of Study 2

5.1 Introduction

The results discussed in the fourth chapter yielded interesting results pertaining to the variables in the acquisition of L2 sounds. To reiterate, the groups of Study 1 are seen below.

Table 5-1: Subject Groups of Study 1

Group A: Perceptual input and metalinguistic explanation (n=4)
Group B: Metalinguistic Explanation (n=4)
Group C: Control Group (n=4)

Within the domains of perception of foreign language sounds, we noted that the perceptual abilities of Group A improved drastically after receiving only one treatment, which is compatible with the view that both perceptual input and metalinguistic explanation are crucial in the L2 acquisition process. Group B’s perception improved as well, but not in the same manner as Group A, which suggests that metalinguistic explanation is key as well. The effects of these two variables were confirmed in the results of the control group, which showed no improvement.
The speech production task results yielded interesting results as well. We noted that Group A initially produced lateral phones with F2 frequencies near the Spanish norms, around 1000 Hz, and after receiving treatments containing only perceptual input continued to produce “lighter” [l] allophones. Group B yielded results that more slightly reflected what was expected, with initial [l] F2 productions of approximately 850 Hz, then during the posttest produced allophones with F2 frequencies of over 1000 Hz. Both Group A and B showed significant improvement in production over Group C.

Although Groups A and B showed us intriguing improvements in speech perception and production, we can also note that each subject group had a low number of participants. Increasing the N would while maintaining identical task structure undoubtedly yield more significant results.

As previously discussed, Spanish and English are different with respect to /l/ coda velarization, a process not seen in Spanish. Generally, velarized /l/s tend to have a resonating F2 frequency of approximately 800 Hz whereas non-velarized laterals tend of have a higher F2 of about 1200 (Ladefoged, 2003). The aim of the Study 2 was to test whether the effects of ET, perception, and metalinguistic explanation of non-velarization via ANGEL exercises at home could improve the participants’ L2 speech production. If so, they can spend the limited class-time on other parts of language learning.

In Study 2, thirty participants were randomly assigned to 3 groups and then received different pronunciation training during the study. The treatments are listed below in Table (5-2):
Table 5-2: Participant groups of Study 2

Group A (13 participants): ET + perception + metalinguistic explanation (Instruction type 1)

Group B (12 participants): ET + metalinguistic explanation (Instruction type 2)

Group C (15 participants): received no treatment (Control Group, Instruction type 3)

Pretests and posttests were completed by participants before and after the 8 week study in a manner identical to Study 1. In the tests, participants completed identical word-naming tasks discussed in detail in Chapter 3 (with tokens in random order) and the tasks were digitally recorded. L2 frequency is expected to increase after receiving treatment. Because English and Spanish have some cognates in common which might affect the pronunciation, those cognates are marked in the dataset.

5.2 Results of speech perception and production tasks

The following figures (5-1 through 5-6) show the results by participant of the weekly perception tasks that were completed on ANGEL as well as the speech production tasks completed during the pretest and posttest.

The following figures yield results that would be anticipated. Figure 5-1 shows us the results of the weekly perceptual treatments of Group A, who received ET, as well as perceptual input and metalinguistic explanation on ANGEL. We note that scores on the pretest range from 30% to 95%, and after treatment 1 scores range from 65% to 95%. By
week 4 we note that all scores are at 80% and above, and participants continue to score above 80% for the remaining treatments (except for two participants who score 75% during week 7).

Figure 5-1: Perception scores of Group A

The results of the perceptual treatments for Group B (those who received ET and metalinguistic explanation) are quite similar, seen in figure 5-2. Again, on the pretest scores range from 30% to 95%. After the first treatment, there is a sharp increase in the scores, as they range from 65% to 100%. However, we see that after the second

1 Series = participant
treatment, two participants’ scores regress to 60% and 65%, and during weeks 3 and 4 two participants continue to score in the 60th percentile. We can also note that by week 5 all scores are 85% or higher, and for the remaining treatments all scores are at 80% or higher.

Figure 5-2: Perception scores of Group B
Upon examination of the control group results (figure 5-3), we note that scores again range from 35% to 95%. Unlike the results of Groups A and B, we see that after the first treatment, scores still range between 35% and 65%, and after the second treatment scores are still relatively lower than the preceding groups, ranging between 45% and 100%. During weeks 3 and 4 we see scores ranging from 45% to 95%, and during week 5 one participant regresses to the 30th percentile. By week 8 scores are lower compared to the two treatment groups, ranging between 60% and 90%, and during the posttest scores ranges from 65% and 90%.

These results, as well as those of Group A and B, indicate that the factors of ET, audible input, and metalinguistic explanation have an impact on the discrimination of L1 and L2 sounds, at least in the exercises here. However, as seen in Study 1, we may not be able to claim that audible input yields improvement in perceptual abilities.
In figures 5-4 through 5-6 we see the results of the speech production tasks of the pretests and the posttests completed in the lab on campus. What is curious about these results is the almost identical performance of Groups A and B, seen in figures 5-4 and 5-5. Both groups produced [l] phones with a mean F2 frequency of approximately 830 Hz (or rather a more velarized allophone) during the pretest. During the posttests, both groups again had similar mean F2 values of over 1000 Hz, a characteristic of a less-velarized phone. As with the perceptual scores, the speech production scores are significantly different than those of the control group, who produced F2 frequencies
ranging from only approximately 827 and 828 Hz on all blocks of the pretest and posttest, seen in figure 5-6.

**Figure 5-4: Production scores of Group A**
Figure 5-5: Production scores of Group B

GROUP B

Figure 5-6: Production scores of Group C

GROUP C
5.3 Speech production statistical analysis

The data was analyzed in SAS (Littell et. al., 2006). The experiment design is a split-plot design which requires different error terms to test the treatments on different experiment units. SAS Proc Mixed procedure is specifically designed for such situations. In this analysis, we treat student groups as whole plots, and the instructions are called the main treatment. Each whole plot is divided into two parts called subplots (or split-plots), and cognates or non-cognates are assigned to two parts. In the following sections, I will further discuss the use Analysis of Covariance (ANCOVA) in SAS.

5.4 Exploratory data analysis

In this experiment we have 2 kinds of instructions, but since there was not a group only receiving perception/audible example instruction, we have to treat the instruction as a factor with 3 levels. The first level of treatment had perception and metalinguistic instruction, the second level had metalinguistic instruction only and the third level had no instruction, then in this report we treat them as treatment 1, 2 and 3 respectively. We also treat the word class (cognates/non-cognates) as a factor with 2 levels. The treatment factor was applied on the group level and word class factor was applied on subject level. First, mean and variance of differences in F2 frequency between treatments were calculated. (Note that in Study 1, tokens we coded if they [al]C consonant cluster, but that variable was excluded from the
analysis.) Then we must calculate and plot the means for instruction and word class, seen in 5-3.

**Table 5-3: Mean and variance for 3 groups**

<table>
<thead>
<tr>
<th>instruction</th>
<th>Obs</th>
<th>N</th>
<th>Mean</th>
<th>Std Dev</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>26</td>
<td>26</td>
<td>164.6312500</td>
<td>12.2598826</td>
<td>136.2300000</td>
<td>184.9866667</td>
</tr>
<tr>
<td>2</td>
<td>24</td>
<td>24</td>
<td>167.7172631</td>
<td>10.7138355</td>
<td>144.6166667</td>
<td>189.0917647</td>
</tr>
<tr>
<td>3</td>
<td>30</td>
<td>30</td>
<td>0.8509476</td>
<td>10.7598898</td>
<td>-25.6482759</td>
<td>20.7866667</td>
</tr>
</tbody>
</table>

**Table 5-4: Mean and variance for groups and word class**

<table>
<thead>
<tr>
<th>cognate</th>
<th>instruction</th>
<th>Obs</th>
<th>N</th>
<th>Mean</th>
<th>Std Dev</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cognat</td>
<td>1</td>
<td>13</td>
<td>13</td>
<td>158.9858334</td>
<td>13.5978064</td>
<td>136.2300000</td>
<td>184.9866667</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>12</td>
<td>12</td>
<td>163.1163889</td>
<td>11.1846120</td>
<td>144.6166667</td>
<td>175.9566667</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>15</td>
<td>15</td>
<td>2.5583678</td>
<td>11.1949663</td>
<td>-25.6482759</td>
<td>20.7866667</td>
</tr>
<tr>
<td>Noncog</td>
<td>1</td>
<td>13</td>
<td>13</td>
<td>170.2766667</td>
<td>7.7354400</td>
<td>149.9435294</td>
<td>180.3658824</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>12</td>
<td>12</td>
<td>172.3181373</td>
<td>8.2901925</td>
<td>157.2482353</td>
<td>189.0917647</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>15</td>
<td>15</td>
<td>-0.8564726</td>
<td>10.4041247</td>
<td>-15.9788235</td>
<td>19.6835294</td>
</tr>
</tbody>
</table>

From table 5-4 we can see Group A and Group B have much larger differences than Group C, although the plot does not show that there is clear difference between Group A and Group B. The table also shows that there is a small difference between cognates and non-cognates and possibly an interaction for the 2 factors.
Figure 5-7: Histogram for Means

Figure 5-8: Scatterplot for Difference against Pre-test frequency

2 Instruction 1 is Group A, Instruction 2 is Group B, and Instruction 3 is Group C.
In the scatterplot of 5-8 we see the pre-test frequency is different among the control group (labeled instruction 3 in the SAS graph) than Groups A and B (instruction types 1 and two respectively in SAS). It is possible that the control group performed well enough at the beginning of the treatments and might not have improved as much as participants who did not perform that well at the beginning. Thus we plot the difference against the pre-test frequency and on the plot we can see for Group A and Group B the difference decreases when the pre-test score increases, but this does not happen for Group C (seen in 5-8). In such a situation we need to consider the pre-test score in the test. Since the pre-test frequency was determined before any treatments had been applied and might have influence on the subject final improvement, we need to treat it as covariate in the model.

5.5 Analysis of Covariance (ANCOVA)

The experimental unit for instruction treatments is the groups; the study is also interested in whether word class affects the participants’ pronunciation. Thus, word class (cognates/non-cognates) is considered the treatment associated with experimental units at the participant level. The participants in a particular group only received one treatment so they are nested in that group (treatment). This experiment involved two sizes of experimental units: (1) the group to which the instructions were applied and (2) the participant nested with group. The covariate, pre-test frequency, is measured on each participant, which is the small-size experimental unit. For this experiment it is best to use
the analysis of covariance (ANCOVA, Kuehl, 2000; Montgomery, 1999). ANCOVA is a combination of ANOVA and regression for continuous variables, which tests whether certain factors (instruction type and word class in this case) have an effect on the response variable (frequency difference) after removing the variance for which quantitative predictors (covariates, pre-test score) account. The analysis of variance table displays quantities that measure how much of the variability in the response variable is explained and how much is not explained by the factors. From the following table, we can get a significance test of whether the factors are related in the response variables represented by the sample.

Table 5-5: Type 3 tests of fixed effects

<table>
<thead>
<tr>
<th>Effect</th>
<th>Num DF</th>
<th>Den DF</th>
<th>F Value</th>
<th>Pr &gt; F</th>
</tr>
</thead>
<tbody>
<tr>
<td>instruction</td>
<td>2</td>
<td>67.6</td>
<td>25.34</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>cognate</td>
<td>1</td>
<td>57.3</td>
<td>5.31</td>
<td>0.0249</td>
</tr>
<tr>
<td>instruction*cognate</td>
<td>2</td>
<td>57.1</td>
<td>1.98</td>
<td>0.1479</td>
</tr>
<tr>
<td>pre</td>
<td>1</td>
<td>68.2</td>
<td>36.05</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>pre*instruction</td>
<td>2</td>
<td>67.7</td>
<td>18.08</td>
<td>&lt;.0001</td>
</tr>
</tbody>
</table>

Table 5-5 indicates that both main factors are significant but their interaction is not significant (with p-value 0.1479). The pre-test frequency is significant as a covariate, and it has a significant interaction with the instructions.
Because the covariant pre-test frequency is significant and it also has a significant interaction with the instruction factor, we need to test how the response variable difference is affected at different stages of pre-test frequencies. This can be seen in Table 5-6.

**Table 5-6: Least square means**

<table>
<thead>
<tr>
<th>Effect</th>
<th>cognate</th>
<th>instruction</th>
<th>pre</th>
<th>Estimate</th>
<th>Standard Error</th>
<th>DF</th>
<th>t Value</th>
<th>Pr &gt;</th>
<th>t</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>instruction 1</td>
<td>Cognat</td>
<td>837.69</td>
<td>116.28</td>
<td>1.7411</td>
<td>69</td>
<td>&lt;.0001</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>instruction 2</td>
<td>Cognat</td>
<td>837.69</td>
<td>109.90</td>
<td>1.6712</td>
<td>69</td>
<td>&lt;.0001</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
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<td>Noncog</td>
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<td>-2.9941</td>
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<td>4.7055</td>
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<td>1.33</td>
<td>0.1887</td>
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</table>
The output above is the Least Squares Means for different level of instructions at different level of pre-test frequencies. For all the pre-test frequencies, instruction type 1 and type 2 are clearly different from 0 which means that students who received those instructions improved their pronunciation. When the pre-test frequency increases, the difference tends to be smaller. But for all pre-test frequencies, instruction type 3 is not significantly different from 0, which indicates that students who were in this control group did not improve their pronunciation as expected. The overall means for cognates and non-cognates shows that students are exhibiting less improvement in the cognates.

The differences of least squares means (seen below in 5-7) compares the instructions by pairs. From the table above we can find that for all pre-test frequencies instruction type 1 and type 2 are not significantly different from each other but they are both significantly different from type 3 (control).
**Table 5-7:** Differences of least square means

| Effect   | instruction | instruction | pre | Estimate | Standard Error | DF | t Value | Pr > |t| | Adj P |
|----------|-------------|-------------|-----|----------|----------------|----|---------|------|---|----------|
| instruction | 1  | 2 | 810.0 | 0 | 3.6536 | 7.7271 | 69 | 0.47 | 0.6378 | 0.884 3 |
| instruction | 1  | 3 | 810.0 | 0 | 199.09 | 6.4957 | 68.4 | 30.65 | <.0001 | <.000 1 |
| instruction | 2  | 3 | 810.0 | 0 | 195.43 | 6.4832 | 67.9 | 30.14 | <.0001 | <.000 1 |
| instruction | 1  | 2 | 830.0 | 0 | 1.7004 | 3.4728 | 60 | 0.49 | 0.6262 | 0.876 5 |
| instruction | 1  | 3 | 830.0 | 0 | 176.44 | 3.0519 | 58.5 | 57.81 | <.0001 | <.000 1 |
| instruction | 2  | 3 | 830.0 | 0 | 174.74 | 2.7682 | 47.4 | 63.12 | <.0001 | <.000 1 |
| instruction | 1  | 2 | 850.0 | 0 | -0.2528 | 3.3973 | 56.2 | -0.07 | 0.9409 | 0.997 0 |
| instruction | 1  | 3 | 850.0 | 0 | 153.79 | 3.4260 | 61.3 | 44.89 | <.0001 | <.000 1 |
| instruction | 2  | 3 | 850.0 | 0 | 154.04 | 3.8423 | 62.4 | 40.09 | <.0001 | <.000 1 |
| instruction | 1  | 2 | 870.0 | 0 | -2.2060 | 7.6258 | 68.9 | -0.29 | 0.7732 | 0.954 9 |
| instruction | 1  | 3 | 870.0 | 0 | 131.14 | 7.0331 | 68.7 | 18.65 | <.0001 | <.000 1 |
| instruction | 2  | 3 | 870.0 | 0 | 133.34 | 7.9582 | 68.7 | 16.76 | <.0001 | <.000 1 |
5.6 Residual Issues

In the experiment we do not have a group that only received the audible examples of target form (like those seen in Study 1. If there were one, the experiment would have a 2 way factorial design at instruction type level. It would then be possible to evaluate the effect of audio-input, metalinguistic and their interaction. It might strongly enhance the research.

In addition, although Study 2 involved more participants that Study 1, this experiment also has a relatively small sample size, which might affect the strength of the conclusion.

5.7 Conclusion

The production data show us that Group A and Group B both show greater improvement than Group C, but Group A does not show a significant difference from Group B. In other words, students who received additional audible examples do not perform better than those students who only received metalinguistic explanation.

The one thing we can conclude from the perceptual exercise results and the statistical analysis of speech production is that both audio input and metalinguistic explanation are crucial in adult L2 phonological acquisition, as seen with the improvements in both perception and production of Groups A and B.

The results of the weekly speech perception exercises yield additional interesting results concerning the role of metalinguistic explanation in language acquisition. Although we have seen in the literature of Chapter 2 that perceptual training can play a role in L2 phonological acquisition, the data in figures 5-1, 5-2, 5-4, and 5-5, as well as the
ANCOVA’s, suggest that metalinguistic explanation may be sufficient to improve the acquisition of L2 phonology. However, another area that would benefit from further expansion would be the inclusion of a participant group that received only audio input, as seen in Bradlow et. al. (1997).

Another piece of provocative data is shown in the production of cognates and noncognates of Groups A and B. As seen in figure 5-7, participants produced less target-like forms for cognates. We might expect the opposite, as it has been observed that quicker production of correct forms that were cognates in the participants’ L1 (Costa. et. al. 2000). Modification of the token list to include an identical amount of cognates and noncognates may help to remedy this, as well as lengthening (or simply duplicating) the number of tokens. On the other hand, the less target-like production of cognates may also be a sign of interference of L1, given the strong activation of the English form and thus a more English-like production. This finding accords with that of Jacobs (2007).
Chapter 6

Conclusion

6.1 Introduction

In this chapter, I will discuss the originally anticipated results, followed by what the statistical analysis of both the perception and production exercises showed us. I will conclude the chapter with a discussion of several deficits of the study and how they might possibly be corrected in future follow-up investigations.

6.2 The original hypothesis and research questions

We recall that the one of the original research questions of this thesis was examination of the factors of perceptual input in the form of audible examples, metalinguistic explanation and explicit training (ET) and their role in the acquisition of second-language sounds, doing so outside the classroom utilizing technology. If successful, implications would suggest that L2 phonology can be addressed at the elementary and intermediate levels of language learning.
6.3 Study 1 Results

Interestingly, statistical analysis of the speech production pre- and posttest revealed that subjects in both Group A and Group B in Study 1 improved in their L2 production abilities, supporting the notion that both perceptual input and metalinguistic explanation are key factors in the process of acquisition of L2 sounds. Unfortunately we cannot establish which of the variables is the more significant, or which one better facilitated the improvement process.

If we modified the subjects to look like something below in table 6-1, we might have more conclusive data as to the individual roles of ET, perceptual input, and metalinguistic explanation.

Table 6-1: Subject groups for follow-up study/studies

<table>
<thead>
<tr>
<th>Group</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>Group A</td>
<td>perceptual input</td>
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<tr>
<td>Group B</td>
<td>metalinguistic explanation</td>
</tr>
<tr>
<td>Group C</td>
<td>perceptual input &amp; metalinguistic explanation</td>
</tr>
<tr>
<td>Group D</td>
<td>control</td>
</tr>
</tbody>
</table>

Within the domains of speech production, curious data was yielded by Group A, who produced target-like forms before even completing the first online treatment. However, each group consisted of only four participants. Increasing the N would undoubtedly yield more conclusive results.
6.4 Study 2 Results

Statistical analysis of the speech production in the pre and post-test of the value of the F2 in the coda lateral segments revealed that participants in both Group A and Group B improved in their L2 production abilities with respect to this variable, supporting the notion the perceptual input and metalinguistic explanation can modulate the process of acquisition of L2 sounds. However, we do not have sufficient evidence to support the claims from Study 2 that perceptual input alone plays a central role in the acquisition process, due to the organization of the subject groups. Organization of participant groups in the following manner may help to yield more conclusive results.

Table 6-2: Subject groups for follow-up study/studies II

Group A: perceptual input
Group B: metalinguistic explanation
Group C: perceptual input & metalinguistic explanation
Group D: ET
Group E: ET & perceptual input
Group F: ET & metalinguistic explanation
Group G: ET, perceptual input, & metalinguistic explanation
Group H: Control

Also, due to the difference in sample size of the groups of the two studies, we are not able to claim with certainty that additional ET aids in the accurate production of L2
phones (i.e. Group B in Study 1 received only metalinguistic explanation whereas in Study 2 Group B received both metalinguistic explanation and ET).

The control group was exposed to L2 input in the listening comprehension exercises, even though no specific information was given regarding pronunciation. We can conclude that the completion of the online exercises did aid in the improvement of L2 perception and production.

6.5 Implications for future research

The topic of (acquisition of) L2 phonology is indeed a provocative subfield in SLA, one worthy of future investigations. In both studies we have been presented with data from perceptual task results and speech production results that also are congenial with the notion that L2 phonology can be improved with the incorporation of online-based tasks completed outside of the classroom.

Perhaps the most salient experimental design property that will benefit from modification in future follow-up studies is the number of participants. We recall that the number of subjects in Study 1 was twelve, and in Study 2 was thirty. If the number of participants is substantially increased, we will undoubtedly strengthen evidence for any factors central in the acquisition process and for a theory in SLA.

Other avenues for improvement are organization of subject groups, inclusion of other L2 phonetic properties in the weekly perception tasks, and the length of the actual perception tasks themselves.

We note that the factors examined in Study 1 were perceptual input and metalinguistic explanation. However, in Study 2, the groups were:
Table 6-3: Subject Groups of Study 2

Group A: ET, perceptual input and metalinguistic explanation
Group B: ET and metalinguistic explanation
Group C: Control Group

We immediately note that the factors ET, perceptual input, and metalinguistic explanation were not isolated into their own subject groups. Even though the number of participants compared to Study 1 is significantly greater, we do not have the empirical grounds to argue which of the factors has a more crucial part, if any, in the acquisition process. If Group A just received perceptual input, Group B metalinguistic explanation, etc, we might be able to see how significant each individual variable is compared to the others.

If the list of tokens is lengthened and made to include items containing other phonetic properties such as VOT, spirantization of the voiced plosives /b, d, g/ to their respective fricative counterparts /β, δ, ɬ/ in the postvocalic position, and vowel quality, we would then have a wider set of variables for which we can test the hypothesis that the kind of pedagogical approach to improving pronunciation here has benefits for a broad range of L2 phonetic categories.

We recall that the purpose of utilizing ANGEL to introduce the student to the phonetic targets under scrutiny was to allow more in-class time to be dedicated to other topics in L2 learning, given that pronunciation training can be cumbersome and often takes a back seat. Thus, the training of other L2 phonetic targets would be done via the internet, outside of the classroom setting. One thing to bear in mind in developing
further studies or in the implementation of this approach in the classroom is that instruction on numerous phonetic properties may be too much input for the learner.

6.6 More accurate measurements of /l/ velarization

The remaining section will discuss the acquisition of velarized and non-velarized allophones in other studies which carried out their analyses using spectral data (as opposed to native/non-native judges of a given language), and how the degree of velarization was attained.

Martínez-Dauden and Llisteri (1991) examined the degrees of velarization displayed Spanish monolinguals and Spanish/Catalán bilinguals, all learning French as a second and third-language respectively. Of the above Romance varieties, Catalán is the only one in which a velarized lateral allophone occurs. Although Martínez-Dauden and Llisteri were specifically looking at the effects of the amount of Catalán usage and its role in the production of the unvelarized laterals in Spanish and French, degree of velarization was simply attained by looking at the F2 frequency of the laterals in certain ‘Vowel-lateral-[e]’ sequences.

Recasens et. al. (1995) looked at the affects that lateral velarization may have on neighboring vowels. As previously stated, Catalán differs from other varieties of Romance and also German, as Catalán is the only one in which the velarized allophone surfaces. Moreover, they argue that the process of velarization can be context free, arguing that the [l] of the area around Barcelona as ‘generally dark’. Sequences of ‘V[l]V’ were recorded by the participants, all of whom were either German or Catalán monolinguals. Specifically, Recasens and his colleagues examined the effect of a velarized consonant would have on a neighboring front vowel [i].
Two separate acoustic measures were taken to determine the degree of velarization of a consonant: F2 and the frequency difference between F1 and F2. The latter measurement differs from the former in that it refers to the resonating chamber in the back of the mouth. The bigger the space in the back of the mouth upon the production of a vowel or other sonorant sound, the higher the F2 frequency will be. F1 frequency is positively correlated with the space in the front of the mouth, and thus inversely related to the degree of velarization (Ladefoged, 1975 & 2001; Recasens, 2004). The difference between F2 and F1 takes into account the contribution of F1, which is inversely related with contact of the velum and back of the tongue (and thus directly related to velarization). For these reasons in future studies both the F1 and F2 of the lateral allophones will be measured to yield more accurate data.

6.7 Residual issues & concluding remarks

The current thesis aims to lend insight into improving L2 phonology outside the classroom via the internet, taking into account the variables of perceptual input in the form of audible examples, type of feedback, metalinguistic explanation, and ET. Data yielded evidence that pronunciation can improve if addressed outside the classroom by manipulating the aforementioned variables. Nonetheless, these studies rendered motivating results that will undoubtedly benefit from future research.
References


course. Mahwah: Lawrence Erlbaum Associates.


Krashen, S., Long, M., & Scarcella. (1979). Age, rate, and eventual attainment in


Appendix A

Language Experience and Proficiency Questionnaire (LEAP-Q)
(Marian et. al., 2007)

Last Name   First Name   Today’s Date
Age    Date of Birth   Male Female

(1) Please list all the languages you know in order of dominance:

(2) Please list all the languages you know in order of acquisition (your native language first):

(3) Please list what percentage of the time you are currently and on average exposed to each language.
   (Your percentages should add up to 100%):
   List language here:
   List percentage here:

(4) When choosing to read a text available in all your languages, in what percentage of cases would you
   choose to read it in each of your languages? Assume that the original was written in another language,
   which is unknown to you.
   (Your percentages should add up to 100%):
   List language here
   List percentage here:

(5) When choosing a language to speak with a person who is equally fluent in all your languages, what
   percentage of time would you choose to speak each language? Please report percent of total time.
   (Your percentages should add up to 100%):
   List language here
   List percentage here:

(6) Please name the cultures with which you identify. On a scale from zero to ten, please rate the extent to
   which you identify with each culture. (Examples of possible cultures include US-American, Chinese,
   Jewish-Orthodox, etc):
   List cultures here

(7) How many years of formal education do you have? ______ ______________________________
   Please check your highest education level (or the approximate US equivalent to a degree obtained in
   another country):
   Less than High School   High School   Some College
   College                Some Graduate School   Masters
   Ph.D./M.D./J.D.        Professional Training   Other:

(8) Date of immigration to the USA, if applicable ___ _________________________________________
   If you have ever immigrated to another country, please provide name of country and date of immigration here.
Have you ever had a vision problem, hearing impairment, language disability, or learning disability? (Check all applicable). If yes, please explain (including any corrections):

Language:
This is my (first, second, third, etc.) language.
All questions below refer to your knowledge of (this language).

(1) Age when you…:
began acquiring this language:
became fluent in this language:
began reading in this language:
became fluent reading in this language:

(2) Please list the number of years and months you spent in each language environment:
Years Months
A country where it is spoken:
A family with whom it is spoken:
A school and/or working environment where it is spoken:

(3) On a scale from zero to ten, please select your level of proficiency in speaking, understanding, and reading from the scroll-down menus:
Speaking (click here for scale)
Understanding spoken language (click here for scale)
Reading (click here for scale)

(4) On a scale from zero to ten, please select how much the following factors contributed to you learning this language:
Interacting with friends (click here for pull-down scale)
Language tapes/self instruction (click here for pull-down scale)
Interacting with family (click here for pull-down scale)
Watching TV (click here for pull-down scale)
Reading (click here for pull-down scale)
Listening to the radio (click here for pull-down scale)

(5) Please rate to what extent you are currently exposed to the language in the following contexts:
Interacting with friends (click here for pull-down scale)
Listening to radio/music (click here for pull-down scale)
Interacting with family (click here for pull-down scale)
Reading (click here for pull-down scale)
Watching TV (click here for pull-down scale)
Language-lab/self-instruction (click here for pull-down scale)

(6) In your perception, how much of a foreign accent do you have in this language? (click here for pull-down scale)

(7) Please rate how frequently others identify you as a non-native speaker based on your accent in this language:
(click here for pull-down scale)
Language:
This is my (first, second, third, etc.) language.
All questions below refer to your knowledge of (this language).

(1) Age when you…:
began acquiring this language:
became fluent in this language:
began reading in this language:
became fluent reading in this language:

(2) Please list the number of years and months you spent in each language environment:
Years Months
A country where it is spoken:
A family with whom it is spoken:
A school and/or working environment where it is spoken:

(3) On a scale from zero to ten, please select your level of proficiency in speaking, understanding, and reading from the scroll-down menus:
Speaking (click here for scale)
Understanding spoken language (click here for scale)
Reading (click here for scale)

(4) On a scale from zero to ten, please select how much the following factors contributed to you learning this language:
Interacting with friends (click here for pull-down scale)
Language tapes/self instruction (click here for pull-down scale)
Interacting with family (click here for pull-down scale)
Watching TV (click here for pull-down scale)
Reading (click here for pull-down scale)
Listening to the radio (click here for pull-down scale)

(5) Please rate to what extent you are currently exposed to the language in the following contexts:
Interacting with friends (click here for pull-down scale)
Listening to radio/music (click here for pull-down scale)
Interacting with family (click here for pull-down scale)
Reading (click here for pull-down scale)
Watching TV (click here for pull-down scale)
Language-lab/self-instruction (click here for pull-down scale)

(6) In your perception, how much of a foreign accent do you have in this language?
(click here for pull-down scale)

(7) Please rate how frequently others identify you as a non-native speaker based on your accent in this language:
(click here for pull-down scale)
Appendix B

Pronunciation Attitude Inventory

The Pronunciation Attitude Inventory

Name (print): Date:

Please answer items 1 - 10 using the following response categories:

5=Always or almost always true of me
4=Usually true of me
3=Somewhat true of me
2=Usually not true of me
1=Never or almost never true of me

1. I’d like to sound as native as possible when speaking Spanish.
   Answer:

2. Acquiring proper pronunciation in Spanish is important to me.
   Answer:

3. I feel like I will never be able to speak Spanish with a good accent.
   Answer:

4. I believe I can improve my pronunciation skills in Spanish.
   Answer:

5. I believe more emphasis should be given to proper pronunciation in class.
   Answer:

6. I try to imitate Spanish speakers as much as possible.
   Answer:

7. I’m concerned about my accent when I speak Spanish.
   Answer:
8. Communicating is much more important than sounding like a native speaker of Spanish. Answer:

9. Good pronunciation skills in Spanish are not as important as learning vocabulary and grammar. Answer:

10. I do not practice a native-like accent in class because of how other students in class would perceive it. Answer:

11. Have you studied phonetics or phonology before? Answer:
    If yes, was this general phonetics/phonology or with an emphasis on Spanish? Answer:

12. What is your major?

13. What is the reason for your interest in learning Spanish?
# Appendix C

**Tokens of Word-Naming Task of Pretest and Posttest in Studies 1 & 2**

\[ y = \text{yes}, \ n = \text{no} \]

<table>
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<th>nonce word</th>
<th>cognate</th>
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<td>y</td>
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Appendix D

Images of the Boston Naming Task

Images were presented in a randomized order for every participant.
Correct Responses:

1. ábaco
2. caballo
3. trípode

4. espaladar
5. árbol
6. cepillo de dientes
7. tenazas
8. zanco
9. estetoscopio

10. esfinge
11. caracol
12. caballo de mar

13. rollo
14. tijeras
15. rueda

16. relojes
17. sierra
18. hipopótamo
19. reina
![Image of a queen]

20. raqueta
![Image of a tennis racket]

21. pirámide
![Image of a pyramid]

22. transportador
![Image of a protractor]

23. palito salado
![Image of a salted cracker]

24. lápiz
![Image of a pencil]

23. pelícano
![Image of a pelican]

24. paleta
![Image of a palette]

25. pulpo
![Image of an octopus]

26. nudo corredizo
![Image of a hanger]

27. hocico
![Image of a snout]

28. hongo
![Image of a mushroom]

29. mascara
![Image of a mask]

30. mapa
![Image of a map]

31. pestillo
![Image of a bolt]

32. lámparas  
33. puerta  
34. iglú  
35. casa  
36. helicóptero  
37. arpa  
36. armónica  
37. percha  
38. hamaca  
37. globo  
38. embudo  
39. flor  
40. espejo  
41. escalera mecánica  
42. dominó
43. dardo
44. corbata
45. brújula

46. peine
47. canoa
48. camello

49. cacto
50. escoba
51. banco

52. cama
53. castor
54. espárrago
55. bellota
56. yugo
57. corona
58. silbato
59. silla de ruedas
60. volcán
Appendix E

Introductions to Weekly Exercises on ANGEL for Group A & B (both Studies)

Introductions for Group B did not contain any audible examples.

**WEEK 1:**

In spoken English, there exists a process called velarization, in which the [l] sound is produced a little bit ‘darker’ in specific contexts. This process does NOT occur in Spanish. Listen to the following word “little” (WAV file located in corresponding sound folder).

Listen to it several times, and say it out loud to yourself. The second ‘l’ should sound a little bit “darker” than the first. This is because the second ‘l’ in the word, spelt “le”, is *velarized*. This happens to the ‘l’ sound in English when the ‘l’ comes before another consonant in a word, or at the end of the word.

During *velarization*, the back of your tongue rises to the **top back** part of your mouth.

Listen to the following words. Also, say them several times to yourself. You will notice that the ‘l’ in these words sounds lighter. This is because every ‘l’ is before a vowel. As stated in the preceding paragraph, the ‘l’ has to be before a consonant or at the end of the word to sound dark.

- **lord** (wav file)
- **lame** (wav file)
- **lard** (wav file)

Now listen to these words. Say them several times to yourself, out loud and slowly.

- **rule** (wav file)
- **ball** (wav file)
- **mole** (wav file)
- **alter** (wav file)
You will notice that in all of these words above, the ‘l’ sound is dark. This is because in all of the words of the first group, the ‘l’ is at the end of the word. In the second group, all of the ‘l’s are before another consonant.

Listen to the following words. Say the following words to yourself. Again, say them several times, out loud. Say them slightly slower than your normal rate of speech:

\textit{Lapel} (wav file)
\textit{Local} (wav file)
\textit{Label} (wav file)

In each of the preceding words, the first [l] should sound slightly lighter than the second, as all of the word final [l] sounds are velarized.

In Spanish, all /l/s are unvelarized. That is, there is no dark /l/ in Spanish. Listen to the following words.

\textit{col} (wav file)
\textit{papel} (wav file)
\textit{azul} (wav file)

Let’s see if you can tell the difference between these two types of ‘l’s. Go to Quiz 1.

**WEEK 2:**

Remember last week we discussed the two types of the ‘l’ sound we have in English; a light ‘l’ which occurs at the beginning of a word or between vowels, and a dark ‘l’, which occurs before a consonant or at the end of a word. See summary below:

**Light ‘l’:**
1. beginning of word
   - leak (wav file)
   - loose (wav file)
   - let (wav file)
2. between vowels
   - allure (wav file)
   - Allegheny (wav file)
   - taller (wav file)

**Dark ‘l’:**
1. before another consonant
moldy (wav file)
elder (wav file)
elk (wav file)

2. end of word
duel (wav file)
coal (wav file)
bell (wav file)

Remember that in Spanish, there is only one type of /l/.

algo (wav file)
aquel (wav file)
mármol (wav file)

No further directions were given, except for those during ET of Study 2. All remaining instructions only contained audible lexical examples.
Appendix F

Weekly treatments of control groups

Participants heard the following script, taken from Repaso by NTC (502-506, 1997). Participants were not presented with a script nor any other type of visual information. After listening to the passage they answered the corresponding questions.

Week 1:

Paraguay y Bolivia son los dos países sudamericanos que no tienen puerto de mar. La República del Paraguay tiene frontera con Bolivia al norte, Argentina al sur, Brasil al este. El río Paraguay divide el país. Al este hay llanuras fértiles, colinas y prados. Al oeste está la llanura del Chaco. La agricultura y la ganadería son las fuentes de riqueza del país. También es importante la explotación de los bosques del Chaco por su madera. Se cultivan el maíz, el algodón, el frijol y el azúcar. Paraguay tiene una población de 4.929.000 habitantes. La capital es Asunción. El español y el guaraní son las lenguas oficiales.

1. Paraguay y Bolivia son los 2 países que no tienen _______.
   A) selvas tropicales
   B) minas abundantes
   C) puerto de mar

2. El río ______ divide el país de Paraguay.
   A) Amazonas
   B) Paraguay
   C) Sudamericano

3. Es importante la explotación de los bosques del Chaco por su ______.
   A) ladrillo
   B) madera
   C) tierra fértil

4. El español y el _____ son las lenguas oficiales de Paraguay.
   A) guaraní
   B) italiano
   C) quechua

5. El país de Paraguay tiene una población de ______.
A) 4.929.000  
B) 4.829.000  
C) 3.929.000

**Week 2:**

**Colombia** limita al norte con el Atlántico, al oeste con el Pacífico, al este con Venezuela y Brasil, al sur con Ecuador y Perú y al noroeste con Panamá. Hay tres cadenas de los Andes que van de norte a sur. Hay una región andina al oeste y tierras bajas al este. En el este corren los afluentes del río Orinoco y del Amazonas. El país es agrícola y minero. Se produce café (un 50% de sus exportaciones), arroz, maíz, azúcar, algodón, plátanos, etcétera. Hay también petróleo, gas natural, esmeraldas (un 90% de la producción mundial), oro, cobre, plomo, carbón, hierro, sal, goma, madera, textiles, cueros y productos químicos. Colombia tiene una población de 34.296.000 habitantes. La capital es Bogotá.

1. ¿Cuántas cadenas de los Andes van desde el norte al sur de Colombia?
   A) 2  
   B) 3  
   C) 4

2. La producción de esmeraldas en Colombia es un ____ % de la producción mundial.
   A) 90  
   B) 85  
   C) 83

3. El país tiene una población de más de ___ habitantes.
   A) 32.000.000  
   B) 33.000.000  
   C) 34.000.000

4. ¿Cuál es la capital de Colombia?
   A) Medellín  
   B) Bogotá  
   C) Barranquilla

5. En el este del país, hay ____.
   A) tierras bajas  
   B) selvas densas  
   C) aldeas pequeñas múltiples
Week 3:

Venezuela limita al norte con el mar Caribe y el Atlántico, al este con Guyana, al sur con el Brasil y al oeste con Colombia. Venezuela tiene tres regiones bien definidas: una cadena de montañas, mesetas que ocupan casi la mitad del país y los llanos (una sabana) del Orinoco, situados entre las dos zonas anteriores. La región cultivada se encuentra en la zona montañosa del noroeste y en la costa. Se produce café, arroz, frutas, azúcar, etcétera. Venezuela es uno de los exportadores más importantes del petróleo y fue uno de los fundadores de la OPEP. También tiene hierro y oro y las industrias de acero, productos petroleros, textiles y papel. La capital es Caracas. La Guaira, que queda a 25 kilómetros de Caracas, sirve de puerto para la capital. Es el puerto más importante del país.

1. Venezuela limita al este con ___.
   A) Guayana Francesa
   B) Guyana
   C) Suriname

2. ¿Cuál es la exportación más importante de Venezuela?
   A) arroz
   B) frutas
   C) petróleo
   D) azúcar

3. ¿Dónde se encuentra la región cultivada?
   A) noreste
   B) sureste
   C) noroeste
   D) suroeste

4. ¿A qué distancia está el puerto principal de la capital, y cómo se llama?
   A) 25, Maracaibo
   B) 26, Caracas
   C) 25, Caracas
   D) 26, Maracaibo

5. ¿Cuántas regiones distintas hay en Venezuela?
   A) 2
   B) 3
   C) 4
1. Un inmenso llano forestal cubre más de ___ % del Perú.
   A) 40
   B) 50
   C) 60

2. Los Andes ocupan ____ % del Perú.
   A) 15
   B) 20
   C) 27
   D) 78

3. ¿Cuáles son las lenguas cooficiales del Perú?
   A) el español y el quechua
   B) el español y el aymara
   C) el quechua y el aymara

4. ¿Cuál es la población del país?
   A) 22.667.000
   B) 21.767.000
   C) 22.767.000
   D) 21.667.000

5. ¿Cuál es la actividad fundamental del Perú?
   A) la ganadería
   B) la agricultura
   C) la minería

Perú limita al norte con Colombia y Ecuador, al este con Brasil y Bolivia, al sur con Chile y al oeste con el Pacífico. Perú se divide en tres regiones naturales que van de norte a sur: 1) la costa árida, al oeste, 2) la montaña o selva, un inmenso llano forestal que cubre más de la mitad del país, 3) en medio de ambas regiones, la sierra constituida por la altiplanicie que dividen valles y los Andes. Los Andes ocupan un 27 por ciento del país. La mayoría de los peruanos pueden vivir en la costa gracias al sistema de riego. Aunque las tierras cultivables son escasas, la agricultura es la actividad fundamental del país. Se producen algodón, azúcar, café, maíz, cereales, cacao, coca, quina, etcétera. Perú produce también cobre, plata, plomo, cinc, hierro, petróleo, etcétera. Perú tiene una población de 22.767.000 habitantes. La capital es Lima. Otras ciudades importantes son Arequipa y Callao. El español y el quechua son las lenguas cooficiales; se habla el aymara también.
1. ¿Cuál es la exportación más importante de Costa Rica?
   A) los muebles
   B) el café
   C) el aluminio

2. El país de Costa Rica tiene una población que es 95% de raza ___.
   A) mestiza
   B) indígena
   C) blanca

3. La capital es ___.
   A) San Juan
   B) San José
   C) San Pedro

4. ¿Cuál es la población del país?
   A) 3.087.000
   B) 3.287.000
   C) 3.187.000

5. Costa Rica es el único país de las Américas que no tiene ___.
   A) guardia nacional
   B) ejército
   C) cuerpo marino
Week 6:

**Puerto Rico** es la isla que queda más al este de las Antillas Mayores. Esta isla rectangular es montañosa y tiene muchos ríos. Su clima es cálido y húmedo. Cristóbal Colón llegó a la isla en su segundo viaje en 1493. En 1917 se les concedió a los puertorriqueños la nacionalidad estadounidense. Puerto Rico es un Estado Libre Asociado a los Estados Unidos. Los puertorriqueños tienen los mismos derechos que tienen los ciudadanos estadounidenses salvo el derecho de votar en las elecciones nacionales. Viven según la Constitución y las leyes de Estados Unidos. A principios de 1993, el Gobernador de Puerto Rico declaró el inglés y el español las lenguas cooficiales de la isla. San Juan es la capital de Puerto Rico. Las otras ciudades más importantes son Ponce, en el Caribe, y Mayagüez, en la costa occidental. La isla tiene una población de 3.580.332 habitantes. Hay más de dos millones y medio de puertorriqueños que viven en Estados Unidos continental. Puerto Rico tiene cultivo de café, plátanos, piñas, tomates, caña de azúcar, tabaco, etcétera. La industria principal es la fabricación de productos farmacéuticos y químicos, maquinaria y metales, productos alimenticios, ropa y petróleo.

1. ¿Cuándo descubrió Cristóbal Colón la isla de Puerto Rico?
   A) su primer viaje a las Américas
   B) su segundo viaje a las Américas
   C) su tercer viaje a las Américas

2. ¿Cuándo se les concedió la nacionalidad estadounidense a los puertorriqueños?
   A) 1917
   B) 1918
   C) 1919

3. ¿Cuál(es) es(son) la(s) lengua(s) oficial(es) de Puerto Rico?
   A) el español
   B) el inglés
   C) el inglés y el español
   D) el inglés, el español y el francés

4. ¿Cuál es la capital de la isla?
   A) San José
   B) San Juan
   C) Santa Rosa
   D) Santo Domingo

5. Puerto Rico tiene una población de más de ___.

109
6. ¿Cuántos puertorriqueños viven en los Estados Unidos continental?

A) más de 2 millones
B) más de 2 millones y medio
C) más de 3 millones

Week 7:

La República Dominicana se encuentra en la isla de Santo Domingo, que fue nombrada La Española por Cristóbal Colón. La República Dominicana comparte la isla con Haití. La República Dominicana es montañosa y en general el clima es cálido. La economía se basa en la agricultura, principalmente el cultivo de la caña de azúcar. La caña se cosecha en el este del país. Los otros productos son el cacao, el café, el tabaco y el arroz. Hay refinerías de azúcar, cemento, productos farmacéuticos y maderas. Santo Domingo es la capital. Es la ciudad más antigua de las ciudades americanas fundadas por los españoles y de allí salieron los conquistadores en sus expediciones a Cuba y Puerto Rico. Otra ciudad importante es Santiago de los Caballeros. La República Dominicana tiene una población de 7.515.000 habitantes. Muchos dominicanos emigran a los Estados Unidos por las malas condiciones económicas de su país.

1. ¿La República Dominicana comparte la isla de La Española con cuál otro país?

A) Jamaica
B) Haití
C) Cuba

2. La economía de la República Dominicana se basa principalmente el cultivo de ___.

A) la caña de azúcar
B) del cacao
C) del arroz

3. ¿Cuál es la ciudad más antigua de las ciudades americanas fundadas por los españoles?

A) Santiago de los Caballeros
B) Santo Domingo
C) La Romana

4. El país tiene una población de ___ habitantes.
A) 7.415.000  
B) 7.315.000  
C) 7.515.000  
D) 7.615.000

5. Muchos dominicanos emigran a los Estados Unidos por ___.
   A) razones de guerra civil  
   B) malas condiciones económicas  
   C) tierras infértiles

Week 8:

Uruguay linda con Argentina al oeste, con Brasil al norte, con el Atlántico al este y con el río de la Plata al sur. El país tiene mucha llanura donde se cultivan maíz, trigo, frutas, arroz, avena, etcétera. Las industrias principales son la cárnica, la textil, la producción de vinos, cemento y productos petroleros. Uruguay tiene una población de 3.121.000 habitantes entre los cuales predominan los de raza blanca de origen europeo (89%). La mayoría de éstos son de origen español e italiano. La capital de Uruguay es Montevideo.

1. ¿Qué está al sur de Uruguay?
   A) la Argentina  
   B) el río argentina  
   C) el río de la Plata

2. ¿Cuáles son unos de las industrias principales de Uruguay?
   A) la cárnica, la textil, las frutas  
   B) la cárnica, la textil, la producción de vinos  
   C) la cárnica, la producción de vinos, el azúcar

3. El país tiene una población de ___.
   A) 3.121.000  
   B) 3.221.000  
   C) 3.321.000  
   D) 3.021.000

4. La mayoría de la población uruguaya es de origen europeo, de origen ___.
   A) español  
   B) español y portugués  
   C) español e italiano  
   D) español y alemán
5. La capital del país es ___.

A) Buenos Aires
B) Maldonado
C) Rocha
D) Montevideo
E) Santiago
Appendix G

Weekly treatments of Groups A & B

The Perceptual Ability Pretest was given to all three groups in both Studies. The Posttest took place during week 10, and again was given to all groups. For each question, there was a separate corresponding .wav file on ANGEL. No file was longer than 30 ms. in duration. Files were created using Praat © phonetics software. Files were produced by “cutting” lexical items read from a list by a highly proficient bilingual heritage speaker who spoke American English and a Peninsular variety of Spanish. English .wav files were taken by phonetically cutting words read from an English word list, and the Spanish files were taken from words read from a Spanish word list. Correct answers are indicated in green.

Perceptual Ability Pretest:

.wav file

1. ¿español o inglés? [ iʃ ]
   A) español
   B) inglés

2. ¿español o inglés? [ il ]
   A) español
   B) inglés

3. ¿español o inglés? [ ol ]
   A) español
   B) inglés

4. ¿español o inglés? [ oʃ ]
   A) español
   B) inglés

5. ¿español o inglés? [ ul ]
   A) español
   B) inglés

6. ¿español o inglés? [ ul ]
   A) español
   B) inglés
7. ¿español o inglés?
   A) español
   B) inglés

8. ¿español o inglés?
   A) español
   B) inglés

9. ¿español o inglés?
   A) español
   B) inglés

10. ¿español o inglés?
    A) español
    B) inglés

11. ¿español o inglés?
    A) español
    B) inglés

12. ¿español o inglés?
    A) español
    B) inglés

13. ¿español o inglés?
    A) español
    B) inglés

14. ¿español o inglés?
    A) español
    B) inglés

15. ¿español o inglés?
    A) español
    B) inglés

16. ¿español o inglés?
17. ¿español o inglés?   [ o ]
A) español
B) inglés

18. ¿español o inglés?   [ ow ]
A) español
B) inglés

19. ¿español o inglés?   [ pi ]
A) español
B) inglés

20. ¿español o inglés?   [ pʰi ]
A) español
B) inglés

**Week 1:**

1. ¿español o inglés?   [uɬ]
A) español
B) inglés

2. ¿español o inglés?   [l]
A) español
B) inglés

3. ¿español o inglés?   [ul]
A) español
B) inglés

4. ¿español o inglés?   [ul]
A) español
B) inglés

5. ¿español o inglés?   [il]
6. ¿español o inglés? [ol]
   A) español
   B) inglés

7. ¿español o inglés? [il]
   A) español
   B) inglés

8. ¿español o inglés? [ol]
   A) español
   B) inglés

9. ¿español o inglés? [il]
   A) español
   B) inglés

10. ¿español o inglés? [l]
    A) español
    B) inglés

11. ¿español o inglés? [al]
    A) español
    B) inglés

12. ¿español o inglés? [e]
    A) español
    B) inglés

13. ¿español o inglés? [ow]
    A) español
    B) inglés

14. ¿español o inglés? [o]
    A) español
    B) inglés
15. ¿español o inglés? [pi]
   A) español
   B) inglés

16. ¿español o inglés? [uł]
   A) español
   B) inglés

17. ¿español o inglés? [ił]
   A) español
   B) inglés

18. ¿español o inglés? [ej]
   A) español
   B) inglés

19. ¿español o inglés? [ał]
   A) español
   B) inglés

20. ¿español o inglés? [pʰi]
   A) español
   B) inglés

Week 2:

1. ¿español o inglés? [uł]
   A) español
   B) inglés

2. ¿español o inglés? [ol]
   A) español
   B) inglés

3. ¿español o inglés? [ul]
   A) español
   B) inglés
4. ¿español o inglés?
   A) español
   B) inglés

5. ¿español o inglés?
   A) español
   B) inglés

6. ¿español o inglés?
   A) español
   B) inglés

7. ¿español o inglés?
   A) español
   B) inglés

8. ¿español o inglés?
   A) español
   B) inglés

9. ¿español o inglés?
   A) español
   B) inglés

10. ¿español o inglés?
    A) español
     B) inglés

11. ¿español o inglés?
    A) español
     B) inglés

12. ¿español o inglés?
    A) español
     B) inglés

13. ¿español o inglés?
    A) español
     B) inglés
A) español
B) inglés

14. ¿español o inglés?   
A) español
B) inglés

15. ¿español o inglés?   
A) español
B) inglés

16. ¿español o inglés?   
A) español
B) inglés

17. ¿español o inglés?   
A) español
B) inglés

18. ¿español o inglés?   
A) español
B) inglés

19. ¿español o inglés?   
A) español
B) inglés

20. ¿español o inglés?   
A) español
B) inglés

Week 3:

1. ¿español o inglés?   
A) español
B) inglés

2. ¿español o inglés?   
A) español
B) inglés
3. ¿español o inglés?
A) español
B) inglés

4. ¿español o inglés?
A) español
B) inglés

5. ¿español o inglés?
A) español
B) inglés

6. ¿español o inglés?
A) español
B) inglés

7. ¿español o inglés?
A) español
B) inglés

8. ¿español o inglés?
A) español
B) inglés

9. ¿español o inglés?
A) español
B) inglés

10. ¿español o inglés?
A) español
B) inglés

11. ¿español o inglés?
A) español
B) inglés
12. ¿español o inglés? [iʃ]
A) español
B) inglés

13. ¿español o inglés? [ɪ]
A) español
B) inglés

14. ¿español o inglés? [o]
A) español
B) inglés

15. ¿español o inglés? [eɪ]
A) español
B) inglés

16. ¿español o inglés? [e]
A) español
B) inglés

17. ¿español o inglés? [pʰi]
A) español
B) inglés

18. ¿español o inglés? [pi]
A) español
B) inglés

19. ¿español o inglés? [aʊ]
A) español
B) inglés

20. ¿español o inglés? [əʊ]
A) español
B) inglés
**Week 4:**

1. ¿español o inglés?
   - A) español
   - B) inglés

2. ¿español o inglés?
   - A) español
   - B) inglés

3. ¿español o inglés?
   - A) español
   - B) inglés

4. ¿español o inglés?
   - A) español
   - B) inglés

5. ¿español o inglés?
   - A) español
   - B) inglés

6. ¿español o inglés?
   - A) español
   - B) inglés

7. ¿español o inglés?
   - A) español
   - B) inglés

8. ¿español o inglés?
   - A) español
   - B) inglés

9. ¿español o inglés?
   - A) español
   - B) inglés
10. ¿español o inglés?
   A) español
   B) inglés

11. ¿español o inglés?
   A) español
   B) inglés

12. ¿español o inglés?
   A) español
   B) inglés

13. ¿español o inglés?
   A) español
   B) inglés

14. ¿español o inglés?
   A) español
   B) inglés

15. ¿español o inglés?
   A) español
   B) inglés

16. ¿español o inglés?
   A) español
   B) inglés

17. ¿español o inglés?
   A) español
   B) inglés

18. ¿español o inglés?
   A) español
   B) inglés

19. ¿español o inglés?
   A) español
   B) inglés
20. ¿español o inglés? [e]
A) español
B) inglés

Week 5:

1. ¿español o inglés? [uël]
A) español
B) inglés

2. ¿español o inglés? [l]
A) español
B) inglés

3. ¿español o inglés? [ul]
A) español
B) inglés

4. ¿español o inglés? [ul]
A) español
B) inglés

5. ¿español o inglés? [il]
A) español
B) inglés

6. ¿español o inglés? [ol]
A) español
B) inglés

7. ¿español o inglés? [il]
A) español
B) inglés

8. ¿español o inglés? [ol]
9. ¿español o inglés? [il]
A) español
B) inglés

10. ¿español o inglés? [l]
A) español
B) inglés

11. ¿español o inglés? [al]
A) español
B) inglés

12. ¿español o inglés? [e]
A) español
B) inglés

13. ¿español o inglés? [ow]
A) español
B) inglés

14. ¿español o inglés? [o]
A) español
B) inglés

15. ¿español o inglés? [pi]
A) español
B) inglés

16. ¿español o inglés? [uł]
A) español
B) inglés

17. ¿español o inglés? [il]
A) español
B) inglés
18. ¿español o inglés?  
   A) español  
   B) inglés 

19. ¿español o inglés?  
   A) español  
   B) inglés 

20. ¿español o inglés?  
   A) español  
   B) inglés 

**Week 6:**

1. ¿español o inglés?  
   A) español  
   B) inglés 

2. ¿español o inglés?  
   A) español  
   B) inglés 

3. ¿español o inglés?  
   A) español  
   B) inglés 

4. ¿español o inglés?  
   A) español  
   B) inglés 

5. ¿español o inglés?  
   A) español  
   B) inglés 

6. ¿español o inglés?  
   A) español  
   B) inglés
7. ¿español o inglés?  [ɨ]
A) español
B) inglés
8. ¿español o inglés?  [iɬ]
A) español
B) inglés
9. ¿español o inglés?  [uɬ]
A) español
B) inglés
10. ¿español o inglés?  [aɬ]
A) español
B) inglés
11. ¿español o inglés?  [uɬ]
A) español
B) inglés
12. ¿español o inglés?  [iɬ]
A) español
B) inglés
13. ¿español o inglés?  [o]
A) español
B) inglés
14. ¿español o inglés?  [aɬ]
A) español
B) inglés
15. ¿español o inglés?  [iɬ]
A) español
B) inglés
16. ¿español o inglés?
   A) español  B) inglés

17. ¿español o inglés?
   A) español  B) inglés

18. ¿español o inglés?
   A) español  B) inglés

19. ¿español o inglés?
   A) español  B) inglés

20. ¿español o inglés?
   A) español  B) inglés

**Week 7:**

1. ¿español o inglés?
   A) español  B) inglés

2. ¿español o inglés?
   A) español  B) inglés

3. ¿español o inglés?
   A) español  B) inglés

4. ¿español o inglés?
   A) español  B) inglés
5. ¿español o inglés?
   A) español
   B) inglés

6. ¿español o inglés?
   A) español
   B) inglés

7. ¿español o inglés?
   A) español
   B) inglés

8. ¿español o inglés?
   A) español
   B) inglés

9. ¿español o inglés?
   A) español
   B) inglés

10. ¿español o inglés?
    A) español
    B) inglés

11. ¿español o inglés?
    A) español
    B) inglés

12. ¿español o inglés?
    A) español
    B) inglés

13. ¿español o inglés?
    A) español
    B) inglés

14. ¿español o inglés?
    A) español
    B) inglés
A) español
B) inglés

15. ¿español o inglés? [l]

A) español
B) inglés

16. ¿español o inglés? [a] [l]

A) español
B) inglés

17. ¿español o inglés? [p] [a] [i]

A) español
B) inglés

18. ¿español o inglés? [o] [w]

A) español
B) inglés

19. ¿español o inglés? [p] [i]

A) español
B) inglés

20. ¿español o inglés? [o]

A) español
B) inglés

**Week 8:**

1. ¿español o inglés? [u] [l]

A) español
B) inglés

2. ¿español o inglés? [i] [l]

A) español
B) inglés

3. ¿español o inglés? [u] [l]
4. ¿español o inglés? [ol]
   A) español
   B) inglés

5. ¿español o inglés? [il]
   A) español
   B) inglés

6. ¿español o inglés? [ol]
   A) español
   B) inglés

7. ¿español o inglés? [l]
   A) español
   B) inglés

8. ¿español o inglés? [ul]
   A) español
   B) inglés

9. ¿español o inglés? [al]
   A) español
   B) inglés

10. ¿español o inglés? [l]
    A) español
    B) inglés

11. ¿español o inglés? [il]
    A) español
    B) inglés

12. ¿español o inglés? [ał]
    A) español
    B) inglés
13. ¿español o inglés? [ul]
   A) español
   B) inglés

14. ¿español o inglés? [i bł]
   A) español
   B) inglés

15. ¿español o inglés? [ow]
   A) español
   B) inglés

16. ¿español o inglés? [pi]
   A) español
   B) inglés

17. ¿español o inglés? [pʰi]
   A) español
   B) inglés

18. ¿español o inglés? [o]
   A) español
   B) inglés

19. ¿español o inglés? [e]
   A) español
   B) inglés

20. ¿español o inglés? [ej]
   A) español
   B) inglés

**Perceptual Ability Posttest:**

1. ¿español o inglés? [ i ll ]
2. ¿español o inglés?  
A) español  
B) inglés

3. ¿español o inglés?  
A) español  
B) inglés

4. ¿español o inglés?  
A) español  
B) inglés

5. ¿español o inglés?  
A) español  
B) inglés

6. ¿español o inglés?  
A) español  
B) inglés

7. ¿español o inglés?  
A) español  
B) inglés

8. ¿español o inglés?  
A) español  
B) inglés

9. ¿español o inglés?  
A) español  
B) inglés

10. ¿español o inglés?  
A) español  
B) inglés
11. ¿español o inglés?  
A) español 
B) inglés

12. ¿español o inglés?  
A) español 
B) inglés

13. ¿español o inglés?  
A) español 
B) inglés

14. ¿español o inglés?  
A) español 
B) inglés

15. ¿español o inglés?  
A) español 
B) inglés

16. ¿español o inglés?  
A) español 
B) inglés

17. ¿español o inglés?  
A) español 
B) inglés

18. ¿español o inglés?  
A) español 
B) inglés

19. ¿español o inglés?  
A) español 
B) inglés

20. ¿español o inglés?  
A) español 
B) inglés
I. La p, la t y la k (1)

- Los sonidos p, t, y k en español no son aspirados como en inglés.

- **Experimento**: Corta un pedazo de papel del tamaño de un dedo y colócalo de forma vertical sobre un extremo de tu labio superior. Tienes que lograr que el papel no se mueva al pronunciar estas palabras:

  - Patata
  - Kilo
  - Tomate
  - Campo

La p, la t y la k (2)

Practiquemos el no aspirar con las siguientes palabras en español

- Digan en voz alta las siguientes palabras, con la mano enfrente de la boca, y traten de no aspirarlas.

  - papa   Teto   coca
  - papá   techo   quema
  - Pepe   tabla   cacto
  - pepa   todo   quito
  - pipa   temo   cubre
  - papi   tipo

/l/

- ¿Cómo se pronuncian estas palabras en inglés?
  - [l]
    - long, belong, lose, unlike, release, leisure
  - [l]
    - tall, kill, bull, pal
  - hulking, silk, kilt, melted, helm
  - Before a consonant or word finally

- This does not happen in Spanish. That is, /l/ is never darkened.

- Listen and then repeat the following words:
  - Leche, alto, alumno, palco, algo, late
  - mental, papel, lingüística, elevador, adeluya, celda, árbol, árboles
Articulación normativa de las vocales /i e a o u/ en español

- Las vocales /i e a o u/
  - se articulan de manera corta y tensa
  - siempre son monoptongales
  - NUNCA se reducen a schwa
  - no cambian de posición
  - Compara vocales españolas e inglesas
    - de/day, piensoso/so
      - [e] [o]

Listen and repeat

- English    Spanish
  - day     de
  - baby    bebé
  - oboe    todo
  - paper   papel
  - soul    sol

Aspiration of /p, t, k/

• English [pʰ, tʰ, kʰ]
  - Pʰätty, tʰóp, cʰope

• Spanish [p, t, k]
  - pato, tapa, copa

/l/ darkening before another consonant, or at the end of the word

• Remember, in Spanish we DON'T have darkening of the /l/ EVER.
  • “ideal” vs. “ideal”

Listen and repeat

• leche, alto, alumno, palco, late, mental, papel, elevador, aleluya, celda, árbol, árboles, Lozano

• Listen to the following sentences:
  • (Track 20)
  • (CAMINO ORAL)

• Lalo y Lola leyeron algo lútrico y luego lloraron hasta las altas horas de la noche.
• Lázaro se lastimó la pelvis con la linterna volcada junto a la palma artificial de la sala principal del palacio.
• Un ángel malcriado declaró que el salón estaba totalmente revuelto y por lo tanto se declararía en huelga en el momento menos ideal.
• Luchis y Lulu se largaron el lunes a la una a la playa de Cozumel donde alquilaron un largo automóvil de lujo.
• Algún labrador lujurioso y malintencionado les alteró maliciosamente la velocidad del automóvil, desarreglando el volante y los cables.
• Elsa Beltrán le lanzó violentamente una bola esmalta a Laura Delgado, lo cual resultó en la última instancia en una pelea.
• Lencho volvió a la parte central del hotel para lamerse la sal y el alcohol que alguien le lanzó en silencio desde el portal.
• El ladrón falso salpicó calmadamente la alfombra de la alcoba con algo que al amanecer nos fue fácil palpar.

**Vowels**

- English?
- Spanish?

<table>
<thead>
<tr>
<th>English</th>
<th>Spanish</th>
</tr>
</thead>
<tbody>
<tr>
<td>lay (down)</td>
<td>le</td>
</tr>
<tr>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>o</td>
<td>¿o?</td>
</tr>
<tr>
<td>low</td>
<td>lo</td>
</tr>
<tr>
<td>sole</td>
<td>sol</td>
</tr>
<tr>
<td>day</td>
<td>de</td>
</tr>
</tbody>
</table>
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• Education
  o Ph.D. in Spanish (Linguistics), minor in Linguistics, Pennsylvania State University, August 2011.
  o M.A. in Spanish (Linguistics), Pennsylvania State University, May 2004.

• Academic Appointments
  o Assistant Professor of Spanish & Second-language Acquisition
    Augusta State University
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• Conference Presentations

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• Publications

• Academic Honors and Memberships
  o National Scholars Honors Society, member (inducted September 2008).
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  o Recipient of “Award for Excellence in Teaching”, Department of Spanish, Italian and Portuguese, Penn State, April 1st 2005.
  o Recipient of Bunton-Waller Scholarship Award, August 2002 to May 2003.
  o Award of Honor, Department of Linguistics at SUNY Stony Brook, May 17th 2002.
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• Courses Taught (*at PSU*)
  SPAN 002 Elementary, SPAN 003 Intermediate, SPAN 100 Intermediate Grammar, SPAN 110 Intermediate Conversation, SPAN 200 Intensive Grammar & Composition, SPAN 215 Introduction to Spanish Linguistics, SPAN 414 Phonology